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THE CHICAGO WATERWORKS.

The city of Chicago is justly noted for its business activity, its bold enterprises, its live way of doing things generally; and the history of the city water supply system, from its comparatively small beginning to its latest development, is characteristic of the progressive spirit that pervades the great Northwest. Lying, as the city does, on a flat prairie, with no natural elevation upon which to place a reservoir to insure a proper distribution of the water, and with no desirable near source of supply, the engineers encountered exceptional difficulties in planning and executing the work.

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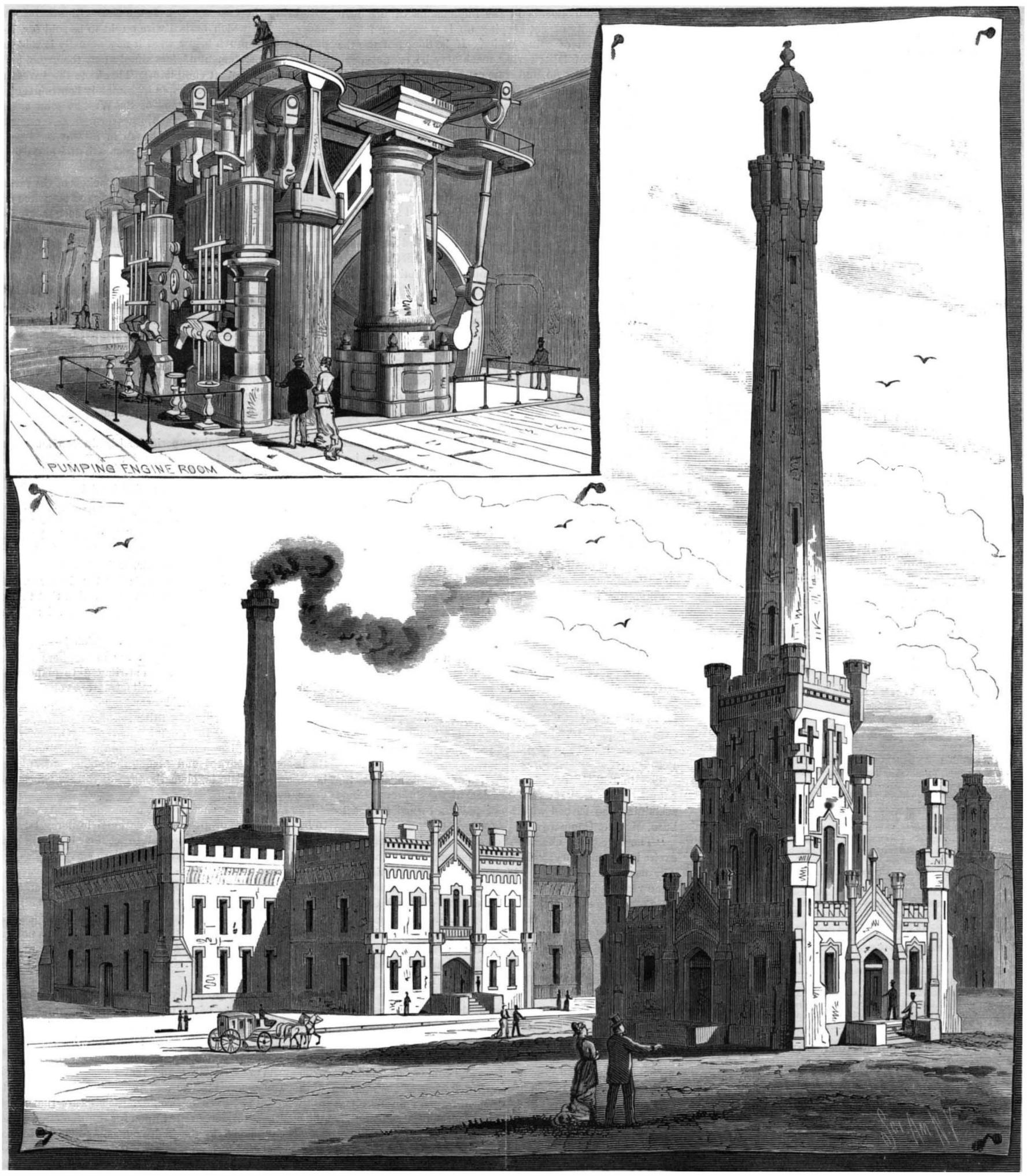

NORTH SIDE WATERWORKS, CHICAGO.

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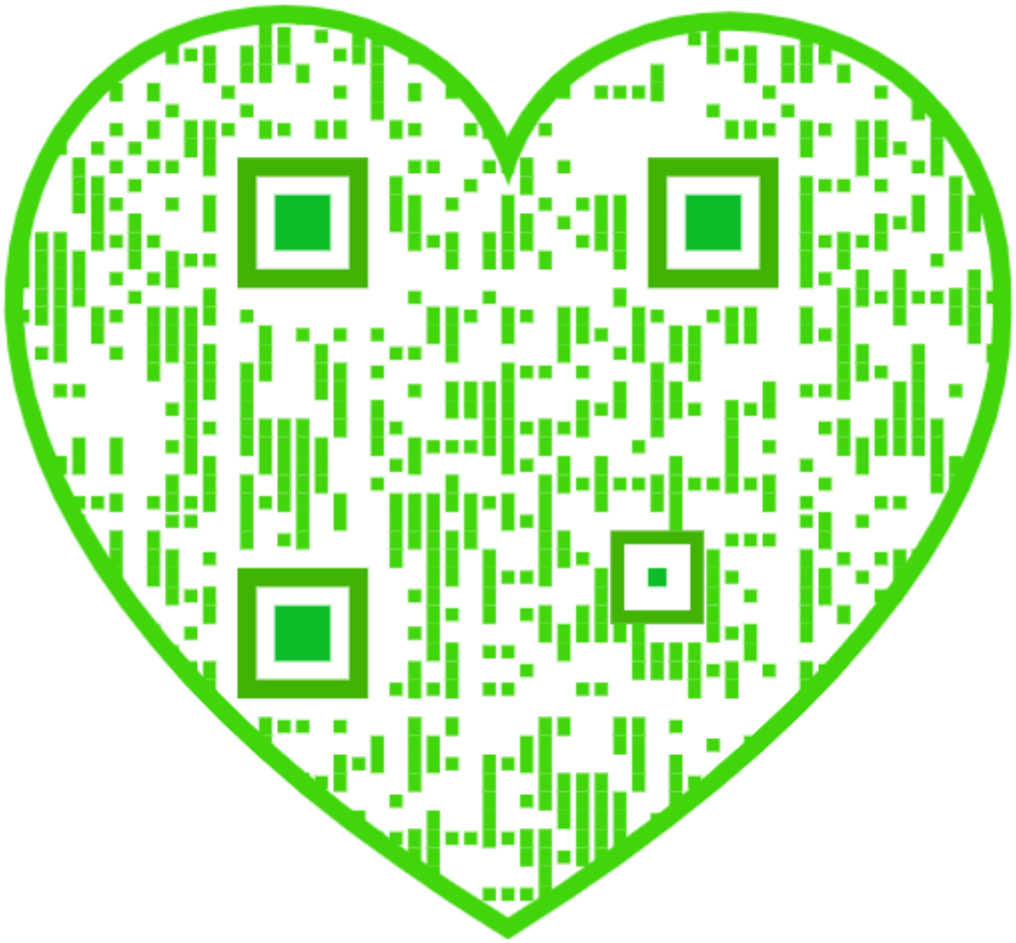

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NEW YORK, SATURDAY, MAY 7, 1881.

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"PATENT PERFIDY."

Under this heading the *Prairie Farmer* devotes a long column to a denunciation of the patent system, exhibiting in its worst phase the spirit of unreason which just now pervades so large a portion of the agricultural world with respect to patent rights.

The grounds for complaint against the patent system appear to be in substance two: First, under its fostering influence inventors are continually introducing new machines, and improvements on old ones, which farmers cannot afford to do without; Second, the manufacturers of the improved machines actually charge money for them, and often get rich by making and selling them in large numbers. Incidentally the manufacturers are given to the wholesale purchase of patent rights from inventors, and erecting upon them greater "monopolies," to "the vexation of the public." In this way the beneficent purpose of the Patent Office, they tell us, has been and is constantly perverted, and the institution turned into an "engine of fraud and oppression."

This perversion of patent rights, our contemporary goes on to say, "presses harder on the farmers than upon any other class of the community. The necessities of existence compel the farmer to keep abreast of the times in all the mechanical improvements in the implements of his business. The penalty of not keeping up is worse than falling behind: it is that of going under. If he does not use the average quality of labor-saving machinery he cannot compete with those who do, and if he cannot compete he cannot live in a country where labor and the cost of living are high. Even his manual labor, separated from machinery, is comparatively valueless, so that, if he cannot use improved implements of his own, he must perforce hire out to use those of his more fortunate or more enterprising neighbors."

It is terrible to contemplate the pressure thus brought to bear upon farmers by this fertility of our inventors, and somewhat amazing to see how tenderly the *Prairie Farmer* regards them and their interests. If the patent system had become an engine for the oppression of the farmers only, the perversion of its function evidently would not be so grievous or unbearable; but it bears even harder upon the inventor, and for his sake its immediate abolition is demanded.

In the words of the *Farmer*, "the patent laws were designed to reward the original inventor of a valuable contrivance; but it is a rare, not to say phenomenal, case in which such intention is carried out. The design is almost invariably stolen by some tricky associate of the inventor, or boldly taken out of his possession by a superior in the establishment in which he works, or wheedled out of him for a song by some speculative capitalist. The sentimental arguments for granting patents may be dismissed summarily. The real inventors never get the benefit of their inventions, and the further pretense of protecting *them* is a hollow mockery."

Strange that the 20,000 inventors who apply for patents every year, and keep on inventing and taking out patents year after year, sometimes scores of them in the course of a lifetime, do not discover the extent to which they are swindled, and strike hands with the Grangers in securing the overthrow of this terrible "engine of fraud and oppression!"

Forgetting syntax and all save the enormity of the crime which the Patent Office commits in giving the deluded inventor his letters patent, the *Farmer* says: "The government takes the applicant's money, the agents takes all he can beg and borrow, and his return is a document seldom worth the paper its matter is printed on."

To put a stop to this official injustice, what remedy can be more summary and logical than the one the *Farmer* proposes when it says, "An act of Congress should declare all existing patents forfeited to the people!" and what proposition could more fitly fall under the heading "Patent Perfidy"?

The immediate occasion of this outburst against the patent system is the recent decision of the Supreme Court sustaining the barbed wire fence patents owned by Washburn, Moen & Company.

"The sweeping character of that decision," says our excited contemporary, "is almost beyond comprehension. The use of barbed wire will be practically unlimited for some years, and the profits of this one firm will distance the tales of the Arabian Nights, the treasures of Monte Christo, or the fortunes of the Bonanza kings. Allowing one firm to bleed hundreds of thousands is all the more doubtful policy from the fact that the firm produces nothing, but simply preys on the work and needs of others, under the protection of government, like the highwaymen and freebooters of the Romantic period."

That the company which own the barbed wire fence patents have a most desirable property is beyond question. That they may make a good deal of money out of their property, if their business is wisely conducted, is altogether probable. But where the bleeding and robbery of hundreds of thousands come in is not so apparent.

The company offer the Western farmers an excellent fencing material, and the farmers will buy it when they cannot do better. If the barbed wire fencing is so much cheaper and more efficient than any other to be had that the prairie farmers cannot do without it, the company are to be congratulated, and the farmers have no obvious reason for complaining. There are a great many species of property that are desirable, and that men would like to get without paying therefor the market price—land and cattle and corn, as well as fence material—but the intensity of that desire is no just ground for the legal or illegal seizure of such property; and any arguments which go to justify the confiscation of intellectual property justify with infinitely greater force the abolition of property in land. The champions of the farmers will do well, in this connection, to keep in mind the proverbial advice to those who live in glass houses.

In any case the objection to the barbed wire patents is largely sentimental and grossly exaggerated. The *Western Rural* cries out against the "barbed wire fence outrage" as loudly as the *Prairie Farmer*, and demands as shriekily the overturning of the patent system; yet, at the close of a long editorial on the "barbed wire fence monopoly," as an illustration of this "reckless disregard of justice and the interests of our farmers in the management of the patent shop at Washington," it says:

"Some of our subscribers in Iowa inform us that they intend to resort to the use of plain telegraph wire for fence purposes, setting the posts closer together, and using five wires, which they claim will answer the purpose just as well as barbed wire. It will be found, however—we think—that the additional wire, and the additional posts needed, will bring the cost up to a figure that will not be much under that at which barbed wire ought to be sold for, if indeed it comes much below what it now actually is sold for."

This plain statement of fact simply cuts the ground from under the anti-patent complaint. Thanks to the inventions which the barbed wire people legitimately control, they are able to set before the farmers of the West as good a fence as, if not a better fence than, the farmers can otherwise obtain, and in doing this they lessen in no way the freedom of the farmers to invent or construct a better and cheaper fence if they can.

No doubt it would be money in the pockets of the farmers if they could get their fences for nothing, or at prime cost; so it would be apparently to the profit of fence makers and other manufacturers to get their wheat and corn and beef and butter on the same terms. But useful things are not to be had in this world in that way, and fortunately sensible and sober-minded farmers are aware of the fact. The unthinking may be temporarily deluded by the sophistries of those who assume to guide them, but their common sense and sense of justice will dominate in the end.

OZONE AND THE SANITOLOGY OF ODORS.

At the meeting of the (Homeopathic) County Medical Society in this city, April 13, Dr. John S. Linsley read a paper on the "Sanitology of Odors," in which some astounding results were attributed to the influence of ozone in the air.

The old theory of the superior healthfulness of an ozonized atmosphere was not only enlarged upon, but it was shown to the doctor's satisfaction that the more or less remarkable careers of such men as Moses and John Adams and Daniel Webster and Horace Greeley and some of our popular poets, might be traced to the energizing property of an ozonic atmosphere. The atmosphere which "energized" Moses, we presume, must be accepted as specially ozonized, only by inference from its inferred effects, which is a somewhat unsatisfactory basis for an argument; but the doctor was able to point to the fact of more recent observation that the celebrated New Englanders he mentioned were all natives of what he called the ozonic region.

A considerable source of the ozone which is supposed to exert so beneficial an effect upon the atmosphere by disinfecting and "vitalizing" it, was attributed to plants whose foliage, fruit, or efflorescence emits fragrant volatile oils or resinous matters which yield ozone by oxidation. Among our native trees worthy of cultivation for the production of atmospheric ozone, the doctor mentioned Oregon maple, magnolia, pine, basswood, locust, and sassafras; and among the beneficent shrubs and plants, the golden currant, spice bush, azalea, wisteria, clematis, thyme, celery, sweet vernal grass, and clover.

The natural inference is that intending parents who wish to be progenitors of great men—national leaders, statesmen, poets, or what not—will do well to set their homes in ozonic regions, and surround them with as large a variety as possible of ozone-making trees and flowering plants.

It would be cruel to needlessly discourage any enterprise in this direction, for the world needs great men badly, and the suggested method of getting them is not an expensive or unpleasant one. Still it is but fair to say that it is not quite so certain, as the doctor appears to think, that there is ever any large ozone in the air, or that its effects would be as intimated.

A great many pretty hypotheses have been based upon supposed evidences of the occurrence of ozone under certain atmospheric conditions, and the supposed oxidizing and other effects due to its presence; but the whole subject has been thrown into confusion by the discovery that the trusted ozone tests are unreliable, and that the oxidizing principle of the atmosphere may be and probably is in large part, if not wholly, hydrogen superoxide. It appears that most of the reactions formerly relied upon for the detection of ozone are also produced by the hydrogen compound whose existence in the air has been demonstrated; and also that the remaining reactions may be due to other compounds known to occur in the air, as carbonate of ammonium and certain sulphides. The odor sometimes observed and ascribed to ozone is not a trustworthy evidence of its presence, since

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most observers, according to Schoene, are liable to confound the odors of ozone and hyponitric acid. It is alleged further that ozone is not produced by the electric spark in a mixture of oxygen and nitrogen, but only oxide of nitrogen, and it is probably to the latter substance and not to ozone that we must attribute the odor sometimes observed after lightning discharges and sparks from an electric machine. Ozone, however, would appear to be produced by the silent discharge of electricity; but it has been justly observed that we know too little of this form of electrical action as an atmospheric phenomenon to justify our regarding it as a probable source of supply of ozone.

In view of all these uncertainties touching the occurrence and action of ozone in the air, it may be prudent to wait a while before admitting ozone to be quite so powerful a factor of individual or national genius, health, or social development as Dr. Linsley and others would have us believe.

PUBLIC WORKS IN NEW YORK CITY.

The report of the New York Commissioner of Public Works for the last quarter of 1880 contains many facts of more than local interest.

New York now has, south of Harlem River, 334½ miles of paved streets, classed as follows: Stone-block pavements, 229½ miles; cobble stone, 80 miles; macadam, 24½ miles; concrete, ½ mile. There were laid last year 244,807 square yards of pavement, covering twelve miles of streets. During the past four years $1,100,000 have been spent upon new pavements and in restoring old ones, 641,957 square yards of worn out and rotten pavements having been replaced by stone blocks.

An appropriation of $400,000 will be devoted this year to the substitution of stone-block pavement for the old cobble stones, which are all to be removed as fast as they can be. More than nine-tenths of the streets of New York will be paved with stone-blocks when the plan is carried out. All plans for concrete and wooden pavements have been dismissed as unadapted to the city, and the macadam roadbed is used to only a very limited extent.

The sewerage system of the island embraces 376½ miles of sewers, with 4,573 receiving basins. Over 5 miles of sewers and culverts, with 62 receiving basins, were added last year. In the older and more densely populated parts of the city the sewers are in anything but a suitable or desirable condition.

A large amount of work in the way of grading, curbing, guttering, and flagging new streets was done during the year, and a large area of new ground was made available for building.

Over 402 miles of streets are lighted, besides 2½ miles of piers and 61 acres of parks. The number of public lamps was 23,511, an increase of 374. Nearly 14 miles of new gas mains were laid, the entire length of gas mains now exceeding 874 miles. The cost of the public lamps was a little short of half a million dollars. The gas consumed was 321,583,860 cubic feet. One mile of Broadway has been lighted by electric lamps on the Brush system, and many private electric lamps help to illuminate the streets.

THE NATIONAL ACADEMY OF SCIENCES.

The annual meeting of the National Academy of Sciences began in Washington, April 19, the venerable President of the Academy, Professor W. B. Rogers, of Boston, in the chair. The list of papers read included: "The Domain of Physiology," T. Sterry Hunt; "The Compass Plant of the Western Prairie," B. Alvord; "The Solar Constant," S. P. Langley; "The Color of the Sun," S. P. Langley; "On Mountain Observations," S. P. Langley; "On the Relation of Soils to Health," R. Pumpelly; "Reduction to Sea Level of Barometric Observations made at Elevated Stations," Professor Abbey; "Electric Light Photometry" George F. Barker; "On the Relations between Strain and Impact," and "On the Structure of the Feet of Mammals," E. D. Cope; "On the Progress of Pendulum Work," C. S. Peirce; "The Production of Sound by Radiant Energy," A. G. Bell; "On the Carbon Lamp Fiber in the Thermo Balance," G. F. Barker; "Memoir of Count S. F. de Pourtales," Alexander Agassiz; "On the Utilization of the Sun's Rays in Heating and Ventilating," E. S. Morse; "On the Later Tertiary of the Gulf of Mexico," E. W. Hilgard; "An Account of the Land Ice of Kotzebue Sound," W. H. Dall.

At the Executive Session of Thursday, Professor A. W. Wright, of Yale College, and Professor H. A. Rowland, of Johns Hopkins University, were elected members, and the following were elected members of the council; Professor S. F. Baird, Professor Wolcott Gibbs, Cambridge; Professor A. Hall, United States Navy; Professor J. E. Hilgard, Coast Survey; Professor Clarence King, Professor Fairman Rogers, Philadelphia. Professor Simon Newcomb was elected Home Secretary, and Professor J. H. C. Coffin, United States Navy, Treasurer.

THE DATE OF THE GLACIAL ERA IN EASTERN NORTH AMERICA.

Mr. G. F. Wright, in a paper read before the American Association for the Advancement of Science, and published in the February number of the *American Journal of Science and Arts*, has made an attempt to calculate approximately the date of the glacial era in Eastern North America, by studying the depth of one of the bowl-shaped depressions which abound in the moraines and kames of New England. These depressions are of all shapes and sizes, from symmetrical "kettle holes" to ponds and lakes of no mean dimensions. It is evident that they cannot always exist, for they are wearing down at the top and filling up at the bottom. For the same reason we know that they cannot always have been in existence.

The basin chosen by Mr. Wright for his investigations was one located near Pomp's Pond, in Andover, Mass., with a diameter of 380 feet, and having an accumulation of peat 96 feet in diameter at the bottom. It is evident that since the first formation of the crater-like depression no material can have reached the bottom except from three sources: (1) The wash from the sides; (2) the decay of the vegetation growing within the rim; and (3) the dust brought by the winds. The problem is to determine the time it would require these three agencies to fill the bottom of this bowl to a depth of 24 feet, which would be equal to a depth of only 8 feet over its present surface—the present depth (17 feet) being estimated from the angle of declivity. Mr. J. Geikie, following the lead of Mr. Croll and others, who look to astronomical data alone, supposes that the so-called glacial period, whose marks we now study in these low latitudes, synchronized with the last period of high eccentricity of the earth's orbit, which closed about 80,000 years ago, and whose maximum influence must have been exerted about 200,000 or 210,000 years since. But once in 21,000 years the astronomical conditions dependent upon the precession of the equinoxes for a glaciation of the northern latitudes occur, though owing to the present low eccentricity of the earth's orbit this influence is now at its minimum.

The question with the crater-like depression above-mentioned is: Could this have stood with so little change for 80,000 years? or even for 40,000 years, as supposed by Prof. Hitchcock? If the close of the great glacial period be so far back as Mr. Croll and Mr. Geikie estimate, we must believe that detritus could accumulate, in the situation above described, over a surface of the area of the present peat bog, only at the rate of one inch in 1,000 years; while, if we put the close of this period back 10,000, the rate of accumulation would seem as slow as the imagination can well comprehend—one inch in 100 years. These considerations have led Mr. Wright to look with increasing distrust upon the astronomical calculations which are made concerning the glacial period, unless the moraines mark the limit reached at the last semi-revolution of the earth's equinoxes about 10,000 years ago. He believes it evident that the glacial phenomena of New England are comparatively recent in their origin.

PHOTOPHONIC AND SPECTROPHONIC DISCOVERIES.

At the meeting of the National Academy of Sciences, April 21, Prof. A. Graham Bell read an important paper describing at great length the recent investigations made by Mr. Tainter and himself in the field so brilliantly opened by them a year ago. After referring to their earlier observations on the production of sound by radiant energy, Prof. Bell said that at his suggestion and during his absence in Europe, Mr. Tainter had pursued the investigation of the sonorousness of matter under the influence of radiant energy, employing a vast number of substances inclosed in test tubes in a simple empirical search for loud effects. He was thus led gradually to the discovery that cotton-wool, worsted, silk, and fibrous materials generally, produced much louder sounds than hard rigid bodies like crystals or diaphragms, such as had hitherto been used.

Mr. Tainter next collected silks and worsteds of different colors, and speedily found that the darkest shades produced the best effects. Black worsted especially gave an extremely loud sound. As white cotton wool had proved itself equal, if not superior, to any other white fibrous material before tried, he was anxious to obtain colored specimens for comparison. Not having any at hand, however, he tried the effect of darkening some cotton wool with lampblack. Such a marked re-enforcement resulted that he was induced to try lampblack alone. About a teaspoonful of lampblack was placed in a test tube and exposed to an intermittent beam of sunlight. The sound produced was much louder than any heard before. Upon smoking a piece of plate glass and holding it in the intermittent beam, with the lampblack surface toward the sun, the sound produced was loud enough to be heard, with attention, in any part of the room. With the lampblack surface turned from the sun the sound was much feebler.

The experiments were repeated when Prof. Bell returned, and were continued by the two gentlemen together. It was found that when the beam was thrown into a resonator, the interior of which had been smoked over a lamp, very curious alternations of sound and silence were observed. The interrupting disk was set rotating at a high rate of speed, and was then allowed to come gradually to rest. An extremely feeble musical tone was at first heard, which gradually fell in pitch as the rate of interruption grew less. The loudness of the sound produced varied in an interesting manner. Minor re-enforcements were constantly occurring, which became more and more marked as the true pitch of the resonator was neared. When at last the frequency of the interruption corresponded to the frequency of the fundamental of the resonator, the sound produced was so loud that it might have been heard by an audience of hundreds of people.

The extremely loud sounds produced from lampblack demonstrated the feasibility of using this substance in an articulating photophone in place of the electrical receiver formerly employed. In regard to the sensitive materials that can be employed, the experiment indicated that in the case of solids the physical condition and the color are two conditions that markedly influence the intensity of the sonorous effects. The loudest sounds were produced from substances in a loose, porous, spongy condition, and from those that had the darkest or moist absorbent colors. The materials from which the best effects have been produced are cotton-wool, worsted, fibrous materials generally, cork, sponge, platinum, and other metals in spongy condition, and lampblack.

The explanation suggested for the superior loudness of the sounds produced by a dark porous substance, for example, lampblack, was as follows. Said Professor Bell:—"I look upon a mass of this substance as a sort of sponge, with its pores filled with air instead of water. When a beam of sunlight falls upon this mass, the particles of lampblack are heated, and consequently expand, causing a contraction of the air spaces or pores among them. Under these circumstances a pulse of air should be expelled, just as we would squeeze out water from a sponge. The force with which the air is expelled must be greatly increased by the expansion of the air itself, due to contact with the heated particles of lampblack. When the light is cut off the converse process takes place; the lampblack particles cool and contract, thus enlarging the air spaces among them, and the inclosed air also becomes cool. Under these circumstances a partial vacuum should be formed among the particles, and the outside air would then be absorbed, as water is by a sponge when the pressure of the hand is removed. I imagine that in some such manner as this a wave of condensation is started in the atmosphere each time a beam of sunlight falls upon lampblack, and a wave of rarefaction is originated when the light is cut off. We can thus understand how it is that a substance like lampblack produces intense sonorous vibrations in the surrounding air, while at the same time it communicates a very feeble vibration to the diaphragm or solid bed upon which it rests."

As intimated above the lampblack proved to be an efficient as well as economical substitute for selenium and tellurium in the electrical receiver of the photophone.

The investigation of the influence of radiant energy upon various substances, solid, liquid, and gaseous, placed in different parts of the solar spectrum, resulted in the production of a new instrument of physical research which has been called the spectrophone. When different substances were used as receivers it was found that the loudness of the sound varied in point of position upon the spectrum in a remarkable manner. With the lampblack receiver a continuous increase in the loudness of the sound was observed upon moving the receiver gradually from the violet into the ultra red. The point of maximum sound lay very far out in the ultra red. Beyond this point the sound began to decrease, and then stopped so suddenly that a very slight motion of the receiver made all the difference between almost maximum sound and complete silence. With red worsted entirely different results were obtained. The maximum effect was produced in the green at that part where the red worsted appeared to be black. On either side of this point the sound gradually died away, becoming inaudible on the one side in the middle of the indigo, and on the other at a short distance outside the edge of the red. With green silk the maximum was found in the red, with the limits of audition in the blue on the one hand and the ulta red on the other. Hard rubber shavings gave a maximum in yellow. Vapor of sulphuric ether produced no audible effect, until a point far out in the ultra red was reached, when suddenly a musical tone became distinctly audible. Vapor of iodine disclosed its maximum in green. With peroxide of nitrogen distinct sounds were obtained in all parts of the visible spectrum, but no sounds were observed in the ultra red.

The repetition of these tests in connection with an undistorted spectrum, that is, one produced by a diffraction grating, will obviously be necessary before any positive conclusions can be arrived at touching the exact relations of color or wave-length to the sonorousness of different substances.

In its present form the spectrophone is a modification of the ordinary spectroscope, made by substituting for the eye-piece a sensitive substance placed at the focal point of the instrument behind an opaque diaphragm containing a slit, the sensitive substance being put in communication with the ear by means of a hearing tube. With reference to the probable utility of the spectrophone, Professor Bell said:

"Of course the ear cannot for one moment compete with the eye in the examination of the visible part of the spectrum, but in the invisible part beyond the red, where the eye is useless, the ear is invaluable. In working in this region of the spectrum, lampblack alone may be used in the spectrophonic receiver. Indeed, the sounds produced by this substance in the ultra red are so well marked as to constitute our instrument a most reliable and convenient substitute for the thermopile. . . . I recognize the fact that the spectrophone must ever remain a mere adjunct to the spectroscope, but I anticipate that it has a wide and independent field of usefulness in the investigation of absorption spectra in the ultra red."

HOT WATER COMPRESSES IN TETANUS AND TRISMUS.—Sporer has successfully treated cases of tetanus by merely applying to the nape of the neck and along the spine large pieces of flannel dipped in hot water, of a temperature just bearable to the hand (50-55° C.)—*Allg. med.-cent. Zeit.*

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THE CHICAGO WATERWORKS.

[*Continued from first page.*]

remote if not impossible. The first water works in Chicago were commenced in 1851, when the population of the city was about 35,000.

It was then thought that the small quantity of water discharged from the river would not affect the quality of the water in the lake at a point 1½ miles south. The works were put in operation in February, 1854, and consisted of one reservoir, containing about a half million of gallons, and eight and three-quarters miles of iron pipe, beside the pumping engine. The population at this time had increased to about seventy thousand, and the growth of the city, together with the introduction of sewerage and the establishment of packing houses, distilleries, etc., increased the quantity of filth flowing into the lake to such an extent that complaints of the impurity and offensiveness of the water were frequently made, and it was proposed to extend an iron pipe, five feet in diameter, one mile out into the lake, to obtain a supply beyond the effect of the sewage. Various other experiments were discussed, but it was finally decided to extend a tunnel two miles into the lake. The work was commenced May 26, 1864, and the tunnel with all of its appurtenances was completed in March, 1867. In this tunnel provision was made for extension either lakeward or landward without interrupting the supply through it, except for a very short time; but it was not supposed that an extension would be required for many years. The breakage of a siphon under Chicago Avenue Bridge, August 18, 1869, deprived the west division of the city of water for about sixty hours greatly endangering a large portion of the city.

This circumstance led the City Council to direct the Board of Public Works to take immediate action with reference to the wants of the city in this respect.

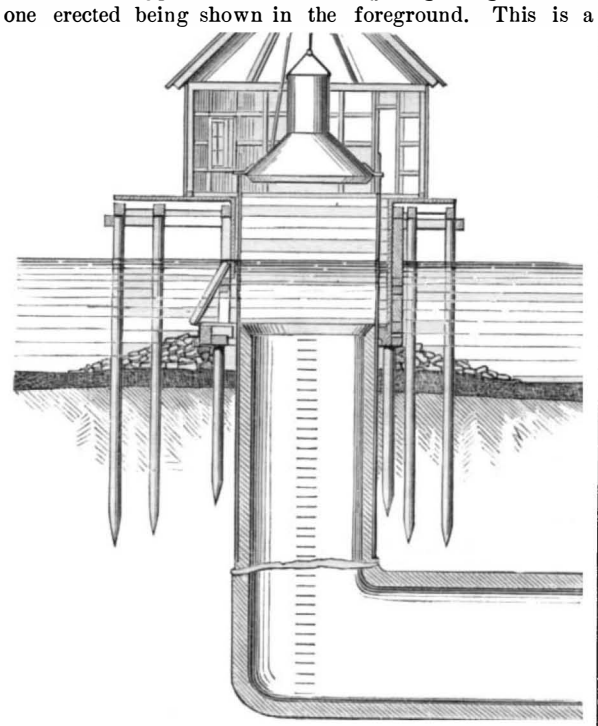
It was decided to build a new tunnel, seven feet in diameter, parallel with the old one, extending six miles into the lake. This great work was commenced July 12, 1872, and finished July 7, 1874. Great difficulty was experienced in sinking both shore and crib shafts, but the work was finally accomplished in the most satisfactory manner. In the construction of the new tunnel, as in the old, provision was made for extending it lakeward should sewage contaminations hereafter make it necessary or desirable.

The crib is a substantial structure of solid masonry, the three lower courses of which are built of granite, on account of its superior frost resisting qualities. The upper courses are of limestone, the arches are of brick, the filling of rubber, and the deck is composed of ordinary concrete, on the top of which is placed a layer of asphalt concrete. The light-house tower is of brick, with an iron stairway. Upon the deck is built a brick house, in which the family of the person in care of the crib resides. No more desolate and isolated place of residence could be imagined than this is in winter. One might as well be on a desert island as far as human companionship is concerned, although there is a telephone line to the shore. But there are many days when the storms blow and the waves beat in their fury, and the broken, floating ice dashes against its sides, that no one goes out from the shore. It is said that some of those who have lived at the crib have found the isolation so intolerable as to almost drive them insane. In the summer, however, boats constantly ply between the shore and the crib, carrying visitors, it being a favorite resort for boating and sailing parties.

Since the completion of the tunnel the immense growth of the city has so increased the sewerage flowing into the lake that it is believed that at times it extends as far as the crib and contaminates the water. Many plans have been suggested to remedy this, and on all hands it is confessed that the problem is a very grave one. It is probable that in ten years from now, with the present rate of increase, Chicago will have a million of inhabitants, and in that case no tunnel extending directly into the lake could insure pure water. The latest suggestion for procuring pure water for the city is that of Chicago's eminent architect, Mr. W. W. Boyington, who proposes that the city shall purchase 100 acres of land in Highlands, some 20 miles north of the city, where the ground is 130 feet higher than the city level. Here should be built an immense reservoir, into which water should be pumped from the lake, and thence conducted by a viaduct to the city.

The shore end of the tunnel is connected with the new North Side pumping works shown in our engraving, and extends to the West Side works. The building is a model of architectural beauty. Its style is castellated, and the tall water tower gives it a very imposing appearance.

The building contains four large pumping engines, two of which are in continual use, while the other two are held in reserve. The general appearance of these magnificent machines is seen in the upper view in the large engraving, the last one erected being shown in the foreground. This is a

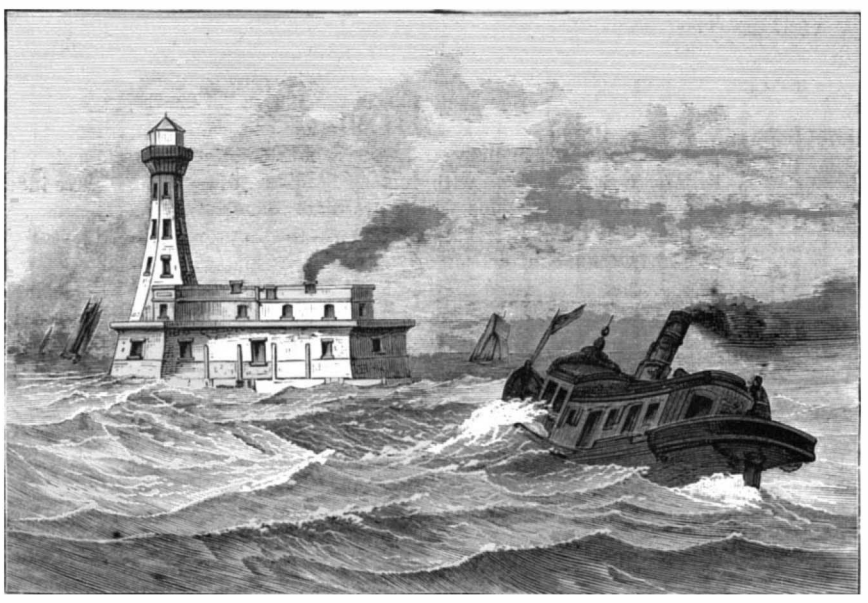


THE FIRST CRIB—SHOWING THE CAST IRON RINGS AND GATE.

double engine, having a capacity of 36,000,000 gallons in twenty-four hours. The steam cylinder is 70 inches in diameter, stroke 10 feet. The water pumps are 57 inches in diameter, stroke 10 feet. The working beams are each 28 feet long and weigh 20 tons. The fly wheel is 26 feet in diameter and weighs 40 tons.

The first engine was erected at these works in 1853. It had a capacity 7,500,000 gallons in twenty-four hours. The second engine, erected in 1857, had a capacity of 13,000,000 gallons in twenty-four hours, and the third had a capacity of 18,000,000 gallons daily. The first and second engines were single, the third and fourth double. These engines are supplied with steam from five boilers 12 feet in diameter and 20 feet long.

In 1871 Chicago had 271 miles of pipe, now it has 500 miles, and it has over 3,000 fire hydrants. This extensive system of water supply has been perfected at an expense of about $8,000,000.



THE CRIB.

SECTION OF TUNNEL.

The Value of Authenticity.

The British Government has bought of Lord Suffolk, for $45,000, a picture by Leonardo da Vinci. Some twenty years ago the picture was stolen from Lord Suffolk's country seat, being cut from the frame. Afterward it was offered for sale in London. When shown to the President of the Royal Academy he pronounced it a copy of the well known "La Vièrge aux Rochers," and no one would buy it. Some one, remembering the robbery, subsequently took pains to inquire into the matter, and traced the picture to the possession of a messenger or door porter at the Foreign Office, Downing street, who produced it, rolled up, from one of the servant's closets there. The picture was taken to Lord Suffolk's, and fitted exactly the cut part, proving incontestably that it was the stolen *chef d'œuvre* of Leonardo da Vinci. That £9,000 is not too much for this picture is inferred from the fact that, at the time when it was restored to its owner, it was remarked that while not authenticated as an original work, £5 could not be got for it, but when it was authenticated it was well worth £10,000.

The Telephone.

The national gathering of telephone men at Chicago, on the 5th April, emphasizes better than anything else the rapid and prodigious growth of that very recent invention. At their previous meeting, held at Niagara Falls, September 7–10, 1880, there was represented $10,000,000 of stock, which, after an interval of only seven months, now represents something like $17,950,000 of stock, all being unpurchasable. Indeed, among all the wonders of the age, there is nothing more wonderful than the invention and progress of the telephone, made practicable only five years ago. Prof. Bell claims that the date of the invention of his method of articulate speech was Jan. 15, 1876. It is already found in use in all parts of the world, as popular and useful in Egypt, New Zealand, and China as in America and Europe. This year alone the English post office authorities have given orders for 20,000 telephones, while its rapid spread in this country is almost beyond calculation. It is introduced with equal eagerness for commercial and domestic uses; it is fast driving out the old fire-alarm telegraphs, while for purely scientific purposes—such as detecting faults in ocean cables without resorting to the old and expensive process of cutting and splicing them—its availability seems beyond calculation.

Much of this is due to the restless energy and genius of its inventor and promoters, for the telephone has drawn to its assistance some of our most profound scientists and brightest business men. It has, in return, brought them in one short lustrum wider fame and ample fortune; the latter statement being best illustrated by an incident which recently occurred in England. At a meeting of the United Telephone Company, last autumn, the discussion developed the remarkable fact that two men who had paid $3,500 for their privilege of acting as the company's agents for the sale of telephones had refused $150,000 offered by the company to cancel that engagement. The number of exchanges in operation in this country has increased in one year from 138 to 408, and the number of instruments in use from 60,873 to 132,692, so that in the United States only one city having a population of over 15,000 is now without a telephone exchange. Other items in the same department show how the introduction of the telephone is being extended abroad as well as at home.

But the uses of the telephone must still be widely extended. Rapid strides are already being made in long-distance telephoning, speech having been recently transmitted from Tours to Brest, a distance of over 800 miles, with a single Leclanché element, the experiment being witnessed by Prime Minister Jules Ferry and other dignitaries. These experiments must be pushed further, for the application of the telephone to long distances has become a necessity, and its use must not stop with the shore. It must be applied to ocean cables, and made audible during the noise of military operations, and even above the roar of battle. Connecting the most remote corners of the earth, like the telegraph, it must rise superior to that invention, and bring them virtually within *speaking* distance.

We have taught ourselves to believe that there is no such word as fail, and with so many men of genius at work perfecting the details of this new agent of intercommunication, with so much capital eager to back their enterprise, and with so much organizing talent and executive ability as is displayed to-day in the telephone business, the great invention of Alexander Graham Bell is

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springing forward to success unparalleled in the history of scientific discovery.—*The Operator.*

IMPROVEMENT IN THE CONSTRUCTION OF FENCES AND POSTS.

The engravings illustrate several forms of iron fence and railings, together with constructive details of the fence fastenings, which have been patented by Mr. J. B. Wickersham, of 505 Cherry street, Philadelphia, Pa., who is manufacturing and has pretty thoroughly introduced the various forms, which have proved highly satisfactory wherever used.

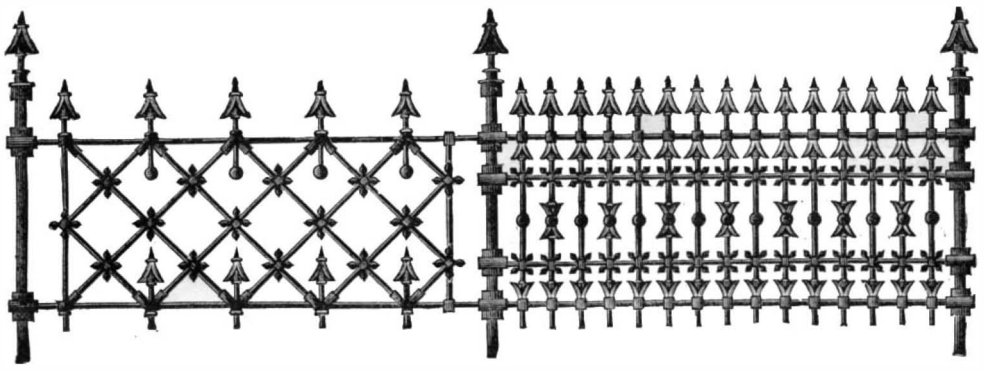


Fig. 1.—**ORNAMENTAL IRON RAILING.**

Figs. 1 and 2 show different forms of railing and fencing. Fig. 5 shows a double fastening for holding the two rods forming the rail of an ornamental iron fence, the fastening being effected by nails, which are broken off and do not show after the fence is finished. The wrought iron bars project through the cast iron ornaments of the railing, as shown in detail in this figure, thereby strengthening the cast iron portions of the iron railing, preventing them from being broken off by mischievous persons. Fig. 3 shows a farm fence on a level, also on an incline, supported by Mr. Wickersham's improved iron post. The fastening of the fence rods is effected by driving nails through holes in the overlapping ends of the rods on opposite sides of the post, as shown in Fig. 4. The rods are grooved longitudinally, so that nails may be driven in at every post through which the rod passes.

Fig. 6 shows the method of fastening flat bars in the posts, also fastening the pickets to the bars. The bars are grooved upon one side to receive the fastening nails.

This iron fence is suitable for farms, lawns, and country places, as a substitute for the barbed wire fences; at the same time it is a more visible fence than strands of wire produce, enabling horses and cattle to see it and avoid injury.

Fig. 9 shows in perspective and in section a fastener for securing a picket to an angle-iron rail by means of an eye, a washer, and a nail.

Fig. 2.—**IRON FENCE.**

Either wrought or cut nails are used for fastening the parts of the fence together, the portions being nailed together as readily and easily as pieces of hard wood. The process might properly be termed keying, but the inventor has appropriately named it "nailing iron to iron." Key-seats are formed in the iron to receive the nails; a hammer and nails are all that are required, with the several parts of the work, to form and erect handsome and durable iron railings and fences of either heavy or light patterns.

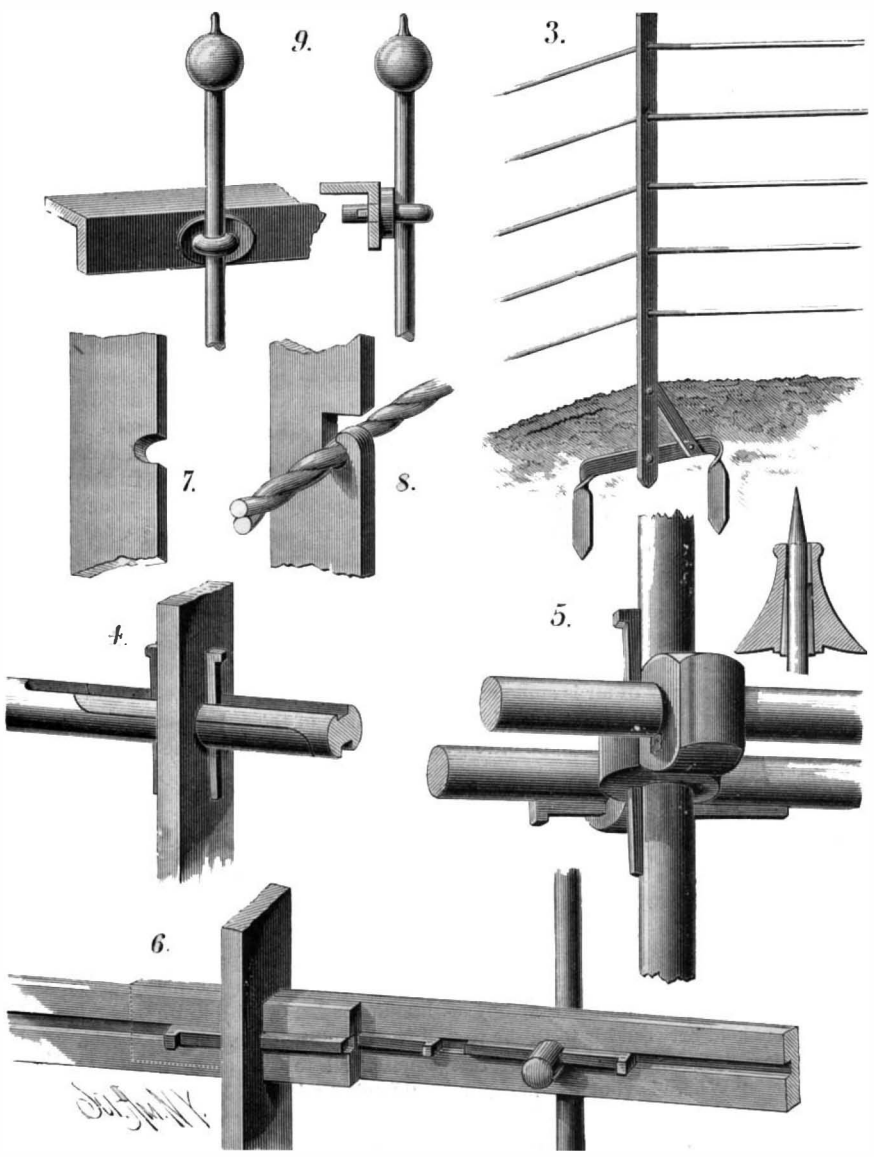
Fig. 7 shows a post with a semicircular notch for receiving barbed wire or wire cable, and a hole for receiving the fastening wire. In Fig. 8 is shown a post having a square notch for receiving a fence wire rod or cable.

The improved posts, shown in Fig 3, have been adapted for round, flat, or square iron, also for barbed and plain wire, to meet the requirements of cheapness, combined with strength and durability. By the method illustrated, the parts of the fence and posts can be quickly and strongly fastened together.

In the manufacture of plain fences composed of horizontal bars or rods for farm purposes, the joints of the rails at the intersections with the posts are secured by various ways in lapping of the rails and by nailing the parts securely together, at the same time allowing the rails and pickets to grade to any inclination of the ground or to expand and contract under changes of temperature. An important feature is the construction and planting of the improved iron post for farm purposes. The object has been to make an iron post which will resist the action of the frost, being so constructed that when planted the parts act in the same capacity as the roots of a tree in sustaining it in an upright position. The brace at the lower part of the post is buried under the ground, and assists in holding. It has been shown that where these posts have been in actual use for several years past they keep their vertical position.

We are informed that these iron posts cost no more than wooden posts. Being of iron they cannot burn in times of fire, or float away in a freshet, and will outlast any post made of wood; besides, there is always an intrinsic value in the old iron.

A large industry has been developed under these patents, and we are informed that this fence is largely coming into public use, supplanting fences of the English and other styles. Furth information may be obtained by addressing the inventor and manufacturer as above.



PARTS OF FENCE FASTENED BY NAILING.

A New Hospital.

Mr. George I. Seney has given the handsome sum of $270,000 for another general hospital, to be located in the southern section of Brooklyn, N. Y. An entire block of ground has been secured. The plan of Mr. Seney contemplates the erection of a number of small buildings rather than a single large one, so that particular diseases may be located and treated apart. Possibly one of these buildings may be made a lying-in department. for which there is ample room; another may be devoted to contagious diseases, for which at present there is absolutely no provision within the city limits. The plans will be matured and work begun within a few months.

The Channel Tunnel.

Close to the western entrance in the Abbot's Cliff, near Folkestone, are the Channel Tunnel works, now progressing under Colonel Beaumont, R.E., by which it is hoped ultimately to realize railway communication between France and England—distance 22 miles. The project, both in design of plan and mode of execution, is practical and ingenious. The chalk strata of England and France are geologically continuous, and the dip of the beds is the same, namely, toward the east, on both sides of the English Channel. The lowermost portion, known as the "gray chalk," is of more clayey nature than the other portions of the chalk formation, and is sufficiently impervious to water to render perforation feasible. The plan proposed is to follow by a descending tunnel the natural dip of the gray chalk towards Dover, until a depth of 200 feet below the sea bed of the Channel is attained. The Channel Tunnel will then be driven horizontally right across from shore to shore. A similarly inclined tunnel on the French side, rising along the direction of the dip of the strata, will make communication again with the upper surface of the land. The gray chalk is thus entered and followed throughout along its natural position—from daylight on the one side, and in its subterranean and submarine depths, to daylight on the other side of the Channel. The works at Abbot's Cliff consist of a short drift-way from the sea front of the "Warren" to the commencement of the trial tunnel, which is circular, 7 feet in diameter, and runs parallel with the existing line of the South-Eastern Railway. It has already attained a length of 300 yards. The chalk is drilled by a circular disk of iron cutters, worked by a compressed air engine by means of a shaft with bevel wheel gearing, the shaft and engine extending for a length of 30 feet. The cutting disk makes two revolutions per minute, and is fed forward a quarter of an inch at each revolution. The total advance of the whole face of the boring is half an inch per minute. The *débris* cut out by the revolving disk is received in a sort of large iron tray, which is hauled back every now and then by a chain worked by an auxiliary air engine, and the water which percolates the chalk is easily kept under by a small donkey pump. The promise of success so far seems good, but the 7-foot tunnel has not yet been driven much, if anything, below low-water tidal level, and we have yet to learn whether any powerful jets of water may get in through fissures as the subterranean depth is increased. Trial shafts have been driven vertically down a considerable distance both on the English and French shores, and there have been no signs of extraordinary difficulty from such sources. Nevertheless, the question of a possible fissure or deep crack in the continuity of the gray chalk itself in mid channel, along a line passing between the "Varne" and the "Ridge," can only be actually settled when the Channel Tunnel itself solves it, and ends, once and for ever, all discussions upon the subject.—*Building News.*

Coal in Venezuela.

In a report by Mr. Plumacher, of the United States Consulate, at Maracaibo (Venezuela), some information is given concerning coal deposits in that country. It is stated that those parts of the country lying between Rio Zulia and Rio Gantatumbo and the Cordilleras, abound in asphalt mines and fountains of petroleum, and generally what is described as a large coal formation. Beyond the Rio Zulia, in the upper part of the department of Colon—that does however not extend to the foot of the Cordilleras—there are stated to be no coal mines, but Mr. Plumacher states that he has been informed by persons of truth and respectability, that the valleys of Cucuta, and the territories of the State of Tachira, abound in coal mines. Near San Antonio, in the ravine called "La Carbonera," exist some of considerable size, from which is frequently dug coal for the use of the smiths' forges in that place; and at the foot of the Cordilleras, on the northern side, there are a considerable number of coal mines, asphalt deposits, and also some fountains of petroleum. In the territory of the department Sucre, just opposite Gibraltar, at the foot of the mountain line, a large quantity of coal and asphalt is found. Mr. Plumacher states that among the samples of coal which he has examined during his

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residence in the State of Zulia, he has only met with one true specimen of lignite. This specimen was found near the Cordilleras and in the direction of the Rio Torondoy, and its quality greatly interested those who examined it. It was ultimately sent to Caracas to be thoroughly examined and tested. The northern basis of the Cordilleras is not much known, and Mr. Plumacher reports that he is not aware whether it contains any coal; but between Escuque and Bettijoque, in the town of Columbia, petroleum wells of an inferior quality are abundant. Reporting generally on the coals which have been so far discovered in this district, Mr. Plumacher states that the driest and most compact of all is that of Tule, and after the many trials to which he has submitted it, he is able to place it among the coals of the best quality, serviceable for all those purposes for which the best lignites are advantageously employed. We further note that, however great the riches manifest on the surface of this region may appear to be in the innumerable fountains and deposits of petroleum, bitumen, and asphalt, such riches cannot be compared with those contained in the immense coal deposits from which those substances proceed. This conviction, which is derived from the nature and circumstances connected with the inexhaustible fountains of petroleum, asphalt, bitumen, and coal already mentioned, supports the opinion that few countries possess the mineral wealth that abounds in the regions around the lake of Maracaibo; and the opinion is expressed that if these coal deposits, which really form the greatest wealth of the State, have not yet been discovered, it is owing to the fact that by far the greater part of its territory is at present in the wild and desert condition in which it was found at the conquest. The government has never interested itself in an exploration of the district, neither have individuals done so, although many may have possessed the means and the knowledge adequate to such an undertaking.

A Big Load of Cotton.

On Saturday, April 2, there arrived in New Orleans the Mississippi River steamer Henry Frank, with the largest cargo of cotton ever brought into the Crescent City—9,223 bales. Other freight brought this cargo up to an equivalent of over 10,000 bales. The Frank is a stern-wheel steamer of not unusual size, but specially designed for the transportation of baled cotton. Of this tremendous cargo, only 2,500 bales were stored in her hold, the balance being built up over the entire steamer, so that her appearance was that of a floating fortress. Only her smokestacks, escape pipes, pilot house, and wheel were visible. Here and there port holes were located to admit air to the furnaces, or ingress and egress to and from the cabin. The bales were tightly packed, fourteen tiers high, the joints being broken as in brickwork. A force of twenty men were constantly on the alert with appliances for quenching any fire that might break out. The cargo was insured for $400,000, and the average weight of each bale was 450 lb. The Henry Frank's cargo was picked up between Memphis and New Orleans, and its arrival safely at the latter city evoked great interest. When it is remembered that 4,000 bales of non-compressed and 6,000 bales of compressed cotton is considered a large cargo for an ocean-going steamer, the size of the Frank's load of the non-compressed article becomes more apparent. The freight would average $1.25 per bale, and the money advanced shippers by the boat on account on this trip was over $20,000.

A Cracked Volcano.

Within the space of ten months Mount Etna had five abundant eruptions of smoke and sand, without any subsequent flow of lava. In one instance, after profound subterranean rumblings and numerous earthquake shocks, there appeared on the eastern side of the mountain a great cloud of vapors and ashes, which escaped by a crevice nearly three miles long. The snows melted suddenly around the summit of the mountain, jets of hot vapor escaped at many places, and the small muddy craters of the western declivity became very active, as is usually the case on the approach of a great eruption. But to the surprise of all observers, within thirty-six hours afterward the volcano had returned to a state of perfect calm. Such a phenomenon has never before occurred within the memory of man. Vicenzo Tedeschi di Ercole attributes it to the existence of an immense opening, which appeared upon the mountain at the time of the eruption of May 26, 1879. He concludes that a very strong pressure is required for the formation of lava, and that a great tension of gas is indispensable in order to raise the lava to the surface of a mountain. It appears probable, therefore, that there will be no reason to fear any further eruption in the cone of Etna as long as the present crevice is open.—*Ann. de Chim. et de Phys.*

Diphtheria.

Dr. Gauthier, of St. Paul, Minn., tells in the Chicago *Medical Review* of his success in an epidemic of diphtheria by the use of iodine. He has treated 200 cases with but two deaths, while before adopting this method he lost one-third of all his cases. The treatment is as follows: The patient is ordered tincture iodine in ten to twelve drop doses every hour, well diluted with water, so long as the fever lasts, subsequently reducing to ten drops every two, and finally every three hours. Local applications are made use of at the same time. These latter should be made by the physician at least twice a day. For internal use the decolorized tincture is used. Bread and starchy articles of diet are used in abundance.

Trial of a Fire Nozzle.

A trial was lately had in Boston of the Monitor or Universal Nozzle, the patent of Andrew J. Morse. The nozzle is of the same pattern as that used upon the fire boat Flanders, and this exhibition was given to demonstrate its value for street service, whether operated by steam engines, or by a powerful pump in the basement of stores. The trial was given under the directions of District Engineer William H. Cunningham, of the third district, and a detail from Engine No. 25, under Captain George W. Frost. Mr. Morse, the inventor, was present, as well as District Engineer Regan and Chief Green, who expressed himself more than satisfied with the results attained. The nozzle, which was securely fastened to a heavy section of plank, was bolted to the pavement, and the power was furnished by the engine in the basement of the Mechanics' Exchange, on Hawley street. The pressure, each trial, was 160 pounds. The first trial was with a 1⅜ inch nozzle, through a single line of hose; the second with a 1½ inch nozzle and a single line of hose; the third with a 2 inch nozzle and three lines; and the last through a 1⅝ nozzle and two lines. The stream in each case was more than expected. Upon the level a tremendous volume of water was thrown for a distance of at least 250 feet, and when played in a vertical direction, the water was thrown completely over the five story buildings on Franklin street. The handling of the pipe was conducted by one man, who had not the slightest trouble in directing the torrents of water that came from the nozzle. It is the inventor's idea that for street service the nozzle should be mounted on a four-wheeled hose carriage, which could be separated at will, the rear wheels having the nozzle and the front wheels the hose.

Orchid Hunting along the Rio Negro.

In a recent letter to the *World*, written at the little settlement of Tauapassua, Rio Negro, Brazil, Mr. Ernest Morris corrects the statement made in a previous letter, that the prince of cattleyas, *C. El Dorado*, is a habitat of high forests. It is a native of the lowlands only, the error now corrected having arisen from his mistaking a schomburgkia for the cattleya. Cattleya El Dorado, he says, is found only on the Negro, but *C. superba* has an immense range, being found not only throughout the whole Rio Negro region, but up the Amazon as far as Teffe and at the mouth of the Japaru. There are several varieties of *C. El Dorado*. The most beautiful has sepals and petals of a clear rose, with lips of a most beautiful crimson and throat of deep orange. The flowers are large and delicately fragrant, and bloom in January or February. Among other orchids collected (and the first that I have seen) was a tall growing epidendrum (?) which produces its flowers from the top of the stem. Six specimens of this plant were found near Tauapassua, every one growing in an ants' nest.

Speaking of his collections, Mr. Morris says: "Besides the orchids I brought with me numerous twigs and branches which were covered with cauchy (a sediment deposited by the water, and very common in low forests), which has poisoned my hands and face. I propose to distribute among the orchid growers at home specimens of this cauchy. It should be found in every hothouse, and it would show the lover of orchids, did he but touch it, what a collector undergoes."

New Method of Packing Fish Eggs for Shipment.

Under the supervision of Professor Baird, U. S. Fish Commissioner, a shipment of 40,000 eggs of the whinnish, or land-locked salmon of Maine, was recently made to Germany, by Mr. Fredrick Mather, of this city. Half the eggs were consigned to the Berlin Fishery Association, and the rest to the Société d'Acclimatation, of Paris. Mr. Mather has recently adopted a mode of packing for shipment which differs materially in detail from that employed last year, in the course of which he shipped 700,000 eggs with a loss of only 7 to 8 per cent. It was the earlier practice to place the ova in shallow trays composed of a wooden frame with a bottom of canton flannel. The trays were placed one upon another in a vertical position in a compartment directly beneath an ice box, from which water a little above the freezing point and well charged with oxygen constantly percolated. In the new method the trays are put into tin boxes one upon the other until each box is full. A well fitting cover is then placed over them, and the boxes, thus nearly hermetically sealed, are packed in ice. There is no percolation of water upon the eggs in this mode of packing. But as the box detains and condenses all moisture arising from the trays, and the supply of air is sufficient for a number of days, it is believed that it will save a larger percentage of the eggs than was possible under the old method, besides occupying somewhat less space.

Climbing Trees for Fish Bait.

In his search for orchids in the forests along the Rio Negro, in Brazil, Mr. Ernest Morris was surprised to see his native rowers run his canoe ashore and proceed to climb a low tree covered with bromelias and large tillandsias. "Those are not orchids," he said. "No matter, patron," replied the Indian; "we want *iscal* (bait)." Wondering at this Mr. Morris watched the boy as, hand over hand, with knife held between his teeth, he passed from limb to limb. Soon a large tillandsia, several feet square, fell to the ground. "Where is your bait?" said he. "Look," said the Indian, who was cutting the leaves close at the base, where the explorer saw between the leaves a mass of worms resembling our common ground worm. How they got there puzzled him. The Indian said they climbed the tree, but this he doubted. At all events, there was bait. What a blessing it would be considered by the American small boy if, instead of digging up flower-beds or turning over old boards, thus losing much valuable time, he could fill his can of bait by climbing a tree? Mr. Morris adds that he has caught fish with the fruit of the tucuma (*Astrocaryum tucuma*), but this was the first time he ever found actual live bait in the trees.

RECENT DECISIONS RELATING TO PATENTS.

United States Circuit Court.—District of Maryland.

EMIGH *vs.* BALTIMORE AND OHIO RAILROAD COMPANY. STEVENS *vs.* SAME. STEVENS, USE OF EMIGH, *vs.* SAME.—PATENT RAILWAY BRAKE.

Bond and Morris, Judges:

1. The question in controversy is, "What saving did the defendant derive from the use of the Stevens brake for the period covered by that patent above what it would have derived from the like use of the Hodge brake during that period?"

2. The difficulties of proving the exact money value of this saving are exceptionally embarrassing.

3. Although this rate may possibly be less than the defendant's actual gain, in the absence of more exact means of computing what that gain was, the court determines upon twenty-five dollars per car per year as the proper rate of profits to be decreed to the complainants in all three of these cases.

4. On these sums the court does not allow interest.

United States Circuit Court.—District of Massachusetts.

ROOT *et al. vs.* LAMB.—SPIRAL TUBES.

Lowell, J.:

1. Where an invention relating to the method of forming spiral tubes was described in terms used in the art of making welded tubes, it not appearing that sheet metal tubes could be made in the manner described: *Held*, that the invention is thereby limited to the making of spiral welded tubes.

2. In describing his invention a patentee may misuse words, but in seeking his meaning the ordinary signification of the words he uses must have weight.

3. A patentee's invention cannot be given a broad construction, so as to cover later inventions, when it appears from the state of the art that there was no opportunity for a great original discovery and the claim is properly limited to the specific improvement.

Bill dismissed.

Mexican Pyramids.

On his return from his tour of antiquarian research in Southern Mexico, M. Charnay reported the discovery of a ruined Toltec city in Tabasco, near the Gulf coast, a city which covers a wide area and must have been in its day a place of considerable importance. The long forgotten town is surrounded and dotted over with small hills, and the builders had utilized these natural elevations by erecting thereon a number of temples, pyramids, and palaces, and had connected their sites by bridges. The largest of the pyramids is 500 feet in height and a second is fully 300. Nature had had more to do with these monuments than art, as the builders had merely shaped the hillocks into pyramidal form and afterward faced them with stone, and steps were also cut in the sides, paved with a mixture of cement and pebbles. From a careful study of the remains of this ancient city M. Charnay is inclined to believe that it was founded between 1150–1180, and that it was in a perfect state of preservation at the time that Cortez invaded Mexico. This opinion was strengthened by a conversation with two well-informed Spaniards whom the explorer encountered in San Juan Bautista, who declared that there were to be found in ancient Spanish records statements to the effect that this city was not destroyed until after the town of Vera Cruz was laid out. M. Charnay is satisfied from indications he observed that there are remains of at least two other Toltec cities further up in the adjacent mountains, but further investigation is postponed for the present.

The Moquis.

In the history of the aboriginal races of this country little is said regarding the Moquis, a branch of the Pueblos, living, where possibly they have lived for a thousand years, in a rocky stronghold in a sandy desert of Arizona. This people number about two thousand five hundred, and occupy six villages, with houses built of stone cemented with sand and clay. These villages, says Dr. Loew, of Wheeler's surveying expedition, are built on the tops of four sandstone mesas, which are separated from each other about eight miles. They occupy the entire width of the mesas, and, standing immediately before the houses, one may look vertically down a depth of three hundred feet. In many places the sides of the mesas are terraced, being used as sheep corrals. In appearance the Moquis come rather nearer to the Caucasian than the rest of his race. These Indians are well clad, and the females especially so. Indian corn is the principal food—the sheep are raised for their wool rather than for the table. From the wool a good blanket is made. The seed corn is planted about one and a half feet from the surface, at which depth sufficient moisture is found to develop and sustain the plant. The Moquis have neither church nor any other place of worship, and the Spanish Jesuits were unable to gain a foothold among them.

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Engineers' Club, Philadelphia.

At a recent meeting Mr. C. W. Buchholz read an interesting paper, calling attention to the rapid increase, during late years, in the weight of the rolling stock of railroads, especially in the locomotive, in the concentration of enormous loads upon one pair of drivers. He described the effect of this heavy weight, when hurled at the rate of 60 miles per hour, or 88 feet per second, upon a light iron bridge. He urged the great necessity of employing competent engineers to design and build such bridges, and of holding them to a rigid responsibility. He doubted the efficiency of trussed bridges with parallel chords and pin connections for spans under 150 feet long, under the present condition of large railroads using modern locomotives and running at a high rate of speed. He suggested solid plate girders and riveted arched trusses as being stiffer and more permanent. In conclusion, he drew especial attention to the great care the modern locomotive imposes upon the engineer in designing the details of all bridges and in determining and proportioning their floor systems.

Notes on the sewerage of Memphis were read by Mr. Wm. Henry Baldwin, giving some personal experiences while engaged in the construction of the work, and also describing some experiments and observations recently made by Major Humphreys, engineer, in charge of the sewers, showing their present condition.

Some topographical features of Memphis were described, showing that, although situated on a bluff, it does not overlook the river, but its surface descends rapidly to a small stream of water in the interior, separating the business from the suburban and rural parts of the city. To avoid polluting this stream, intercepting sewers were placed on each side. Their location, through private property for much of their length, was described, showing how, by avoiding all angles and using curves of 100 feet or more radius, these mains were reduced, practically, to straight lines.

The Memphis sewers being intended to carry off only household waste, the adjustment of their size was shown to be so proportioned that the nearly uniform supply of water afforded a sufficient midday flow to fill the sewers at least half full every day, thus keeping them constantly flushed. Hence the necessity for the entire, and not the partial, exclusion of rain water; for its admission, even from the roofs of dwellings, would render this adjustment of size, and hence the daily flushing of the sewers impossible.

The entire system is thus shown to be self-cleaning, except the upper end of the smaller branches where the water furnished by houses is not sufficient to half fill a six inch pipe, and here the flush tank is required to discharge once a day water enough for this purpose. The operation of flushing being required only at the dead ends, it will be seen that the tanks are widely distant from each other, that their action is entirely independent, and that the failure of any of them to operate would cause only local inconvenience, and have no possible influence on the rest of the system.

The fact that the pipes are entirely clear has been established by passing through them metallic balls but little smaller than the sewers themselves. The velocity of flow in the mains, as determined by recent gaugings, was shown to be such that any substance introduced into any part of the system would be discharged into the sewer in the course of two or three hours, in fact, long before it would have time to stagnate or become foul; and this, together with the complete system of ventilation described, by which a burning piece of paper is drawn into the sewer and not blown out, shows the complete success of the Memphis system of sewerage as a sanitary work.

Mr. Chas. G. Darrach read extracts from the reports of the chemical experts on the present condition of the water supplied to the citizens of Baltimore. This water is supplied from Lake Roland, and when drawn from the taps has such a disagreeable taste and odor as to be useless for domestic purposes. One of the experts found that there was present a volatile nitrogenous substance unknown to chemistry, which he believes to have been the cause of the offensive smell and taste. Whether this organic substance is injurious to health or not he is unable to say, that being a question for physicians. The other expert thought that, as the water was taken from near the bottom of the reservoir (some 25 or 30 feet below the surface), the water needed air. Mr. Darrach advanced the same theory, and in proof stated that the surface water of Tumbling Run Dam in Schuylkill Co., when visited in 1875, was good, while that drawn from the bottom was very offensive to both taste and smell. The water taken from the Fairmount pool during winter, when the ice remains for any unusual length of time, becomes very disagreeable.

Disinfection of Ships.

In devising a system for the thorough disinfection of vessels on board of which cases of smallpox had occurred, the Austrian Government, through its medical experts, resorted to the following method: Sulphur to the extent of twelve grains per cubic meter of the space to be disinfected was first burned in an earthenware vessel or basin, placed in the center of a mass of sand to prevent all risk of fire; every article of clothing, all the linen, etc., were hung across the cabin, the latter being then hermetically closed for three hours, and afterward exposed to the strongest possible draughts of air for twelve hours; finally, the walls, floor, ceiling, etc., were washed with one kilogramme of lime, or one-half a kilogramme of chloride of zinc, to every hundred liters of water.

Prospects of Aerial Navigation.

An interesting and suggestive paper by Dr. Bell Pettigrew F.R.S., was lately read at a meeting of the Balloon Society of Great Britain in the Royal Aquarium. Mr. W. H. Le Fevre, C.E., president of the society, took the chair. Reviewing the principal structural differences of the bodies and limbs by which animals were fitted to move on land, through water, or in air, Dr. Pettigrew pointed out that the analogy which obtained between water and the air as supporting media had strangely and gravely complicated the problem of flight, the idea uppermost in most minds being that a flying creature must float upon the air as a ship floats upon the water. It was this idea that led to the discovery of the balloon, though the balloon could not in any sense at present be regarded as a flying machine. Until endowed with the means of moving from one place to another independently of the wind, as he hoped it would soon be by the ingenuity of a member of the society, a gallant officer, whose plan had not yet been made public, the balloon would remain merely a lifting apparatus. The balloon was inefficient because of its levity; the flying creature was efficient because of its weight. The manner in which wings produced what was practically a solid basis of support in the thin air raised the whole subject of flight.

After describing minutely the structure and action of natural wings, he said, with regard to the speed at which they were driven, that the common housefly moved its wings 330 times per second, or 19,800 times per minute, the butterfly managing only 9 movements per second, or 540 per minute. That the wing was driven more slowly in proportion to its length had been proved by experiment, and this fact was hopeful for the future of flying machines, as there could be no doubt that comparatively slow movements would suffice for driving the long powerful wings required to elevate and propel flying machines. It was evident from what was seen in nature that flight was to a large extent a question of weight and power of body and size and speed of wing. It was satisfactory to find that a solution of the difficult and important problem of artificial flight was being attempted by men of the highest scientific attainments, and that aeronautical societies had of late years been established in France, Austria, and this and other countries. Classifying the various machines by which aerial locomotion had been attempted, he pointed out the causes of failure and the means by which partial success had in some cases been obtained. One of the main difficulties in the way of constructors of machines for aerial transit was the want of a sufficiently powerful and light motor, and in the use of compressed air for this purpose he saw a probable means of doing without the heavy steam or electric engine. Aerial navigation might well appear Utopian to the mass of mankind. It was not, however, on that account impossible. It was a question of time, perseverance, and ingenuity, simply a very complex physical problem, and the *data* for its solution were being slowly but surely accumulated.

Pasteur's New Disease.

In the *Lancet* for February 5, we called attention to the remarkable effects which M. Pasteur had obtained by inoculating rabbits and guinea pigs with the saliva of a child which had died from hydrophobia. The animals, it will be remembered, died thirty-six hours after inoculation, and in their blood was found a bacterial organism, which was quite peculiar, which could be cultivated, and then produced, when inoculated into other animals, symptoms identical with those observed in the others. M. Pasteur did not assert that this was the special microbic organism of rabies, but he considered that his experiments and the microscopical characters of the organism warranted the assertion that the disease was not septicæmia, but a malady altogether new to experimental pathology. In order to ascertain whether a similar affection can be produced by the inoculation of the saliva of persons who have died from other common diseases, M. Pasteur has made some inoculations with such saliva, but without any results. But since the case of hydrophobia was in a child, M. Pasteur applied to M. Parrot for some saliva from children dying from diseases which are regarded as non-specific, and received some from the bodies of three children who had died the preceding day from broncho-pneumonia. In rabbits inoculated with this saliva there was found precisely the same organism as had been discovered in those which had been inoculated with the saliva from the case of hydrophobia. He thinks it certain, therefore, that this organism may often be found, and that it is one of those which have their habitat in the commencement of the alimentary tract. Hence, as he points out, it is not in any way connected with rabies, but it is a surprising fact there should exist in the saliva, at least of children, a special organism which is capable of causing so rapidly the death of rabbits and dogs, even when inoculated in very small doses. It is a fact of very great importance in the etiology of diseases which may be ascribed to microscopic organisms.—*Lancet.*

The Treatment of Tetanus.

Dr. Ria believes that tetanus consists essentially of an exaggerated reflex irritability of the spinal cord, which may be indifferently caused by traumatisms, toxic influences, or so-called rheumatic action. Since the motor tracts of the cord respond in a morbidly exaggerated manner to all sensitive impressions, the main object of treatment will have to be to lessen sensory excitation; for, if this be accomplished, the cord will gain rest, and thus a return to its normal condition will be made possible. Ria, therefore, emphasizes strict isolation of the patients. They are to be separated from their friends, and to be kept from all possibility of sensory impressions. Even the physician or attendant should exercise great care in his intercourse with the patient, lest the latter be disturbed.

Four cases have been successfully treated by the author. In addition to complete and prolonged isolation, several drugs were employed. Thus, in the first case, in which tetanus developed after an amputation of the thigh, chloroform was applied externally by the use of the atomizer. Nearly three ounces were used daily. A gentle sleep was also maintained by the exhibition of chloral hydrate and morphine. The cure was complete in two weeks. In the second case, that of a youth twenty years old, the same plan of treatment was adopted. But one-sixtieth of a grain of atropine was given in conjunction with the chloral hydrate. A cure took place in twenty days. In the third and fourth cases the external use of chloroform was not enforced, and the last case was treated by bromide of potassium and isolation. This one recovered after forty days.—*Medic.-chir. Rundschau, January*, 1881.

Strength of Bronzes.

In a paper lately read before the American Society of Civil Engineers, Professor R. H. Thurston describes a new bronze alloy of maximum strength. The properties of this alloy were ascertained by Professor Thurston in the course of his examination in the mechanical laboratory of the Stevens Institute of Technology of a series of 36 alloys of copper, tin, and zinc, in which the proportions of the copper were varied from 10 to 80 per cent; of the tin, from 10 to 80 per cent; and of the zinc, from 10 to 70 per cent. The results of these experiments pointed to an alloy of the proportions of copper, 55, zinc, 43, and tin, 2, as likely to be that possessing maximum strength, and on Professor Thurston making the alloy he found it to possess a good color, to be close grained, and susceptible of high polish. It was also found to have immense strength, considerable hardness, and moderate ductility, while it could also be forged if carefully heated. For purposes demanding toughness as well as strength, Professor Thurston found, however, an alloy with less tin to be preferable, and he gives the proportions of copper, 55, tin, 0·5, and zinc, 44·5, as affording the best results. This alloy, he states, has a tensile strength of 68,900 lb. per square inch of original area, and 92,136 lb. per square inch of fractured area, while it elongated from 47 to 51 per cent (length of test sample not stated), and reduced to 0·69 to 0·71 of its original diameter before fracture. He also states that the shavings produced by the action of the turning tool on this alloy curled closely, and were tough and strong like those of good iron. Professor Thurston also refers to an alloy discovered several years ago by Mr. J. A. Tobin, but which appears not to be generally known. This alloy, which consists of copper, 58·22, tin, 2·3, and zinc, 39·48, had, when cast, a tensile strength of 66,500 lb. per square inch of original section, while when rolled hot its tenacity rose to 79,000 lb. per square inch, and when moderately and carefully rolled cold, to 104,000 lb. per square inch. It could also be bent double either hot or cold, and was found to make excellent bolts and nuts, while it could be forged at a low red heat.

Fight with a Porpoise.

Mr. R. R. Tanguey, the veteran Rochester sportsman, recently had a fight with a porpoise. In a letter from St. John's River, Florida, he says:

"I will write you of my last struggle with a large porpoise. I was rowing up in what we call the 'witch-tide,' when this monster came running between me and the bluff. I struck him on the head with my oar. He gave a sudden dart and went ashore like Jersey lightning, and I went almost as quickly after him. Then he rushed for the deep water again, but chanced to open his huge mouth. This was my chance, and I rammed the ore in his mouth and down his throat. Then came a tussle—he pulled and I pried. After a long struggle he quieted down; I ran for the boat and got my largest sword. With it I gave him a gash in the throat which made him wild with pain. After a while I got a chance to make him fast to the boat with a line around his tail. A man came to my assistance and we pounded him with clubs until he was dead. We waited for the next tide, as it was hard work to tow a dead porpoise. He doesn't float when dead. By hard work we got him ashore and to camp. Then we measured him. He was nine feet ten inches long, two feet three inches in diameter, and would probably have weighed more than six hundred pounds."

Foreign Bodies in the Eye.

Dr. Thos. R. Pooley (*Archives Ophthalmology*) reports some interesting experiments with the magnetic needle for detecting foreign substances in the eye. He concludes: 1. The presence of a steel or foreign body in the eye, when of considerable size, and situated near the surface, may be determined by testing for it with a suspended magnet. 2. The presence and position of such a body may most surely be made out by rendering it a magnet by induction, and then testing for it by a suspended magnet. 3. The probable depth of the inclosed foreign body may be inferred by the intensity of the action of the needle near the surface. 4. Any change from the primary position of the foreign body may be ascertained by carefully noting the changes indicated by the deflection of the needle.

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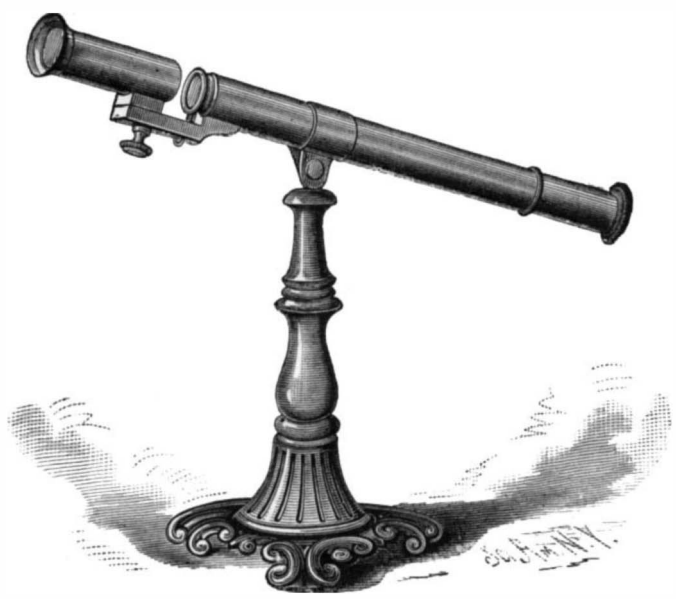
IMPROVED OPTOMETER.

We give an engraving of a novel instrument for measuring the focal lengths of lenses, which is capable of measuring the focus of any lens from three inches to seventy-two inches, while the length of the instrument is only thirteen inches. This is effected by the employment of a convex lens of short focus which shortens the focus of the lens under test. The instrument is in some respects similar to a camera, the object being held in the short detached tube, the lens to be tested being placed between the two tubes; the image of the object is formed on a ground glass carried by the movable tube. There is a scale on the movable tube, and when the image on the ground glass is sharp, the scale indicates the focal length of the lens.

The great utility of this instrument will be understood when it is known that scarcely any spectacle or eye glass has the correct focus marked upon it; and it is often very essential that the exact focus of a lens be known, for example, in matching a glass when its mate is broken, or in supplying spectacles which are but very little different from those already worn.

This instrument is as well adapted to testing concave as convex lenses, and it may be used by any light. It is an ornament to the showcase of a dealer, and will be found very useful by any one dealing in spectacles as well as the regular optician.

This invention was recently patented in this country, and is manufactured by Messrs. Scharpf & Adam, Smith's Arcade, Rochester, N. Y.



NEW OPTOMETER.

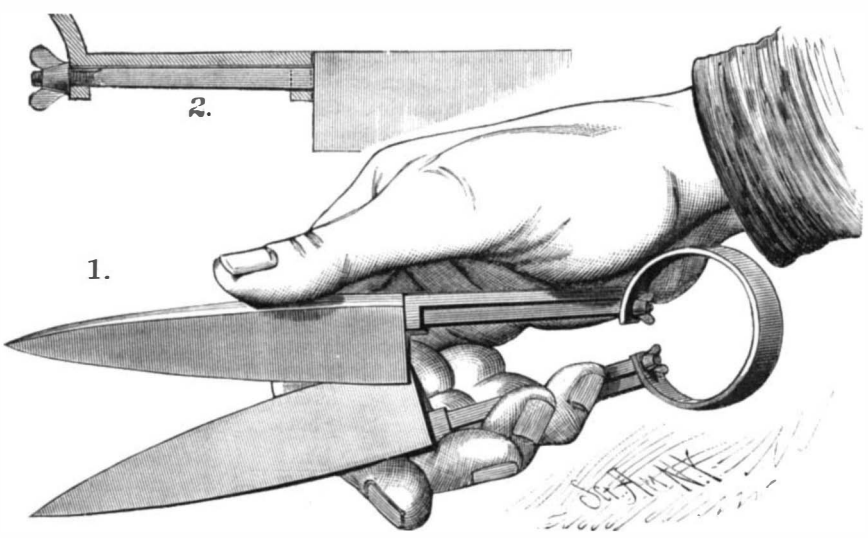
IMPROVEMENT IN ANIMAL SHEARS.

The shears shown in the engraving differ from ordinary sheep shears in having the blades separable from the handle. This construction admits of readily detaching the blades so that they may be ground separately, saving a great deal of time in grinding and avoiding rounding the points and corners and breaking the spring, a thing that often happens with shears of the ordinary construction.

The construction of the shears will be understood from the engraving, Fig. 1 showing the article complete, Fig. 2 being a detail view of a portion of the spring and the end of the shear blade.

The handle of the shears is made with a central spring in the usual manner. On the outer and inner ends of the arms of the handle are formed sockets to receive the shanks of the blades. The apertures of the eyes are made square and slightly tapering, and the shanks are made square and are tapered, so that when the shanks have been drawn snugly into the eyes the blades will be held firmly and rigidly. On the ends of the shanks are cut screw threads to fit wing nuts, by which the shanks can be drawn snugly into the eyes and held securely. The backs of the blades project a little beyond the shanks to form shoulders to rest against the ends of the arms of the handle, so that the backs of the blades and of the arms of the handles will be in line and will form a smooth surface.

This invention was lately patented by Messrs. C. Benavides and J. P. Arthur, of Laredo, Texas.



IMPROVED ANIMAL SHEARS.

The Piute Census.

The statistics of the Nevada Indians were collected by Indian enumerators, whose outfit consisted of a pencil and a sheet of paper. A circle on the paper represented a wigwam or a camp. Within each circle the enumerator placed figures to represent the number of persons counted, squaws and children being represented by different signs. Chief Numana, the supervisor of the Indian count, made up his report from the paper sheets by taking a number of sticks of various lengths to denote adults and children of different sizes, notching those representing females, and sending the sticks in bundles to the Census Office.

This method, though rude, has served to furnish an accurate census of the Piutes.

Proposed Lake Erie and Ohio River Ship Canal.

A report of surveys made by Major John M. Wilson, U. S. Engineers, describes two possible routes for a ship canal connecting Lake Erie with the Ohio River.

The first is by way of the Erie and Wabash Canal to the navigable waters of the Wabash River, which would then make the connection through to the Ohio. This would necessitate the enlargement of the entire route from Toledo to Lafayette to a width of 70 feet at surface and 52½ feet at bottom, with double locks 110 feet long, 18 feet wide, with a depth of 7 feet on the miter-sill, enabling it to pass boats of 240 tons burden, capable of carrying 8,000 bushels of grain, the amount transported by a train of 20 ordinary freight cars.

The second route is by the Miami and Erie Canal, which joins the Wabash and Erie Canal, 10½ miles south of Defiance, thus connecting Toledo and the Lake with the Ohio River. It is proposed to enlarge the entire canal from the Ohio River to Junction City, Ohio—where it unites with the Wabash and Erie—to the dimensions of the New York and Erie Canal: the prism to be 70 feet wide at water surface, 52½ feet wide at bottom, with a depth of 7 feet; all locks double, with a length of 110 feet, width of 18 feet, and a depth of 7 feet on the miter-sill; all canal structures of solid masonry, the superstructure of highway and railroad bridges of iron.

The estimated cost of the first plan from Toledo to Lafayette, Ind., is $24,236,135.17; that of the second, from Toledo to the Ohio River at Cincinnati, is $28,557,173.13.

IMPROVEMENT IN WATER ELEVATORS.

Although the devices that have been invented for elevating water are almost numberless, it must be admitted that there is nothing so free from objections as the old open bucket. The old-fashioned devices entailed considerable labor in raising the filled bucket, but no one doubts that the water was sweeter and better than it would have been had it been drawn from a closed well with a pump of any kind.

Our engraving shows a water elevator embodying all that is good in the old open bucket, and having new features which avoid all objections to the windlass and bucket. In this elevator there are neither brakes nor springs, and the mechanism is so contrived that no accident can occur from the running back of the empty buckets. There are two buckets, worked by the same windlass, one ascending while the other is descending, thus insuring a perfect balance of the buckets and doubling the capacity of the elevator. Ratchets and pawls are dispensed with and noise avoided, yet the bucket is stopped automatically at any given point in its ascent or descent. The mechanism by which this is accomplished is exceedingly simple, consisting of rubber balls placed in tapering pockets on opposite sides of a wheel on the windlass shaft, and in a lever operated by the tilting bucket so as to displace one or the other of the balls and allow the empty bucket to descend, while the ball, remaining in contact with the wheel, serves as a check on the filled bucket being raised.

This elevator is adapted to a well of any depth, since its buckets are perfectly balanced. The shaft of the windlass is mounted on roller bearings, reducing the friction to a minimum.

For the sake of convenience an indicator is placed on top of the housing and connected with the lever that shifts the rubber balls, and shows which way the handle of the windlass should be turned. The size of the curb is two feet by two feet four inches.

Further information in regard to this useful invention may be obtained by addressing Mr. Samuel I. Demarest, agent, Englewood, Bergen county, N. J.

IMPROVED WATER ELEVATOR.

Dangers of Athletic Training.

Absolute health is attained only by the symmetrical development of all parts of the body. The man with muscles of steel and a diseased heart cannot be said to be in good health, and diseases of stomach, heart, and nervous system are often—it may even be said usually—produced by that system of development known as training. At a recent rowing match in Philadelphia, two plucky lads in contesting boats fainted as soon as the race was over. Their condition, which was apparently good, was actually abnormal, and their systems gave way because the strain which their muscles met was too great for their vital functions. Recently a similar but more serious calamity occurred at Sag Harbor. A Brooklyn lad who had taken part in a pedestrian contest, when removed from the track, fell down dead. He had prepared himself for walking and running, and depleted his vital organs to build up his limbs. When the strain came the impoverished and most important part gave way. The severe muscular exercise of college athletes has carried off many fine young men by consumption, heart disease, and other disorders, directly traceable to the absurd overwork required of their bodies. There is a limit of human endurance. That limit is reached when the body is impaired in one quarter to benefit special organs. The severity of the test by which athlete prizes are won seems designed rather to award the laurels to him who is the least healthy, because more unevenly developed, than to the really best man.—*Boston Jour. Chem.*

MISCELLANEOUS INVENTIONS.

With vulcanizers in which the required temperature is obtained by confining the steam, especially those used by dentists, the proper regulation of the temperature is of the utmost importance, and has heretofore been attended with difficulty. The usual method is to regulate the flow of gas to the steam generator by hand; but such method is unreliable. Mr. William E. Gwyer, of New York city, has patented an improved governor for vulcanizing apparatus worked by the steam pressure, by which the pressure, and consequently the temperature, is maintained at a nearly uniform point. The invention consists in a gas cock opened by a spring and closed by steam pressure, for regulation of the flow of gas.

An improved snow shovel, which is simple, light, and durable, has been patented by Mr. Henry E. Vosburgh, of Auburn, N. Y.

Mr. James H. Egan, of St. Johnsville, N. Y., has patented an improved cone attachment for stoves which is designed as an improvement on the cone attachment for which letters patent No. 229,684 were granted to the same inventor July 6, 1880, and its object is to supply air to the cone without interfering with the draught through the grate.

An improved umbrella and sunshade has been patented by Messrs. J. T. Liley and F. S. Liley, of London, England. This umbrella or sunshade is provided with means for automatically expanding or opening it when released from the catch or tip cup which retains it in the closed position.

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Mr. Charles R. Gorgas, of Wooster, Ohio, has patented an apparatus that may be readily used by the surgeon without assistance, and in the case of fractures dispenses with bandages. The invention consists in a frame provided with an extension slide that is fitted for operation by a rack and pinion, so that the power required may be readily applied.

An improvement in spoons and forks has been patented by Mr. Norman S. Boardman, of East Haddam, Conn. The invention consists in combining with the bowl of a spoon or tines of a fork a brass wire and glass tip. The wire is soldered to the bowl at one end, and provided at the other with a glass tip cast on.

Mr. Thomas Harding, of Brooklyn, N. Y., has patented an improved reclining chair that may be readily adjusted to form a reclining chair or bed, and also folded closely for transportation.

An improved road grader has been patented by Mr. James F. McGarry, of Caldwell, Ohio. The object of this invention is to furnish a road grader so constructed that it can be readily turned and used in narrow places, will throw no weight upon the horses' necks, either when loaded or unloaded, and when dumped can be readily drawn back to the place of loading.

An improved nose piece for eyeglasses has been patented by Mr. Fred Terstegen, of Elizabeth, N. J. The object of the invention is to allow the nose rest to be moved in or out of the same plane with the glasses, and by the pressure of a spring to be confined in any particular position, thus insuring firmness to the nose rests, and avoiding the chance slipping of the glasses from their position, and thus injuring the wearer.

An improved stove board has been patented by Mr. A. I. Griggs, of New York city. The object of this invention is to produce a stove board that will not tarnish, and that may be made ornamental without the labor and expense of varnishing and baking the boards.

An improved steam chest for hot-air drying, patented by Alexander Winward, of Accrington, county of Lancaster, England, consists in a sheet of tubes provided with cross pipes as well as inlet and outlet pipes. These tubes may be separate for the greater portion of their length and connected to each other at either end, the tubes opening at each end into a cross pipe or steam way, in such a manner that the steam may pass through them all; or the outsides of the tubes may be joined to each other by a central web extending the whole of their length.

An improved self-chalking holder for chalk lines which chalks the line perfectly, and does not waste or break the chalk, has been patented by Mr. Chauncey Wing, of Greenfield, Mass. The invention consists in a tubular roller or barrel, upon which the string or line is wound, the barrel being provided with two loose end pieces united by a spindle, upon which a cylindrical piece of chalk is loosely mounted and pressed against and into one end of the end pieces by an adjustable spring in such a manner that the end surface of the piece of chalk is pressed against the string or line, which passes through a recess formed by the end surface of the piece of chalk, and a laterally projecting flange of the corresponding end piece.

Mr. John Nagele, of Clarendon, Ark., has patented an improved vehicle wheel hub designed especially for buggies and light wagons, and also adapted to heavy vehicles. The invention consists of a hub provided with open-sided spoke mortises for staggering spokes, of annular caps or flanges fitted over the ends of the hub against the outer faces of the spoke tenons, and of a projecting band or collar, in combination therewith, that encircles the hub between the two sets of spokes and supports them on their inner faces.

MANUFACTURE OF REAL LACE BY MACHINERY.

Considerable attention has lately been paid in Europe to the manufacture of lace by machinery. A company has been organized in Paris with a capital of 2,500,000 francs to develop M. Malhère's lace loom.

This loom is a marvel of mechanism, having from 1,800 to 2,000 spindles, which are put in motion at the same time

Fig. 1.

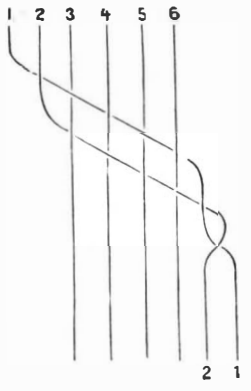

Fig. 2.

that 200 to 300 pins are placed or displaced. But the inevitable complication of the members of which it is composed, though a just object of admiration, is a legitimate cause of apprehension as to the regular working of the apparatus. In order to work economically the lace machine must move with great rapidity, and without very frequent interruptions; but whether these conditions can be realized is a matter that can be proved only by experiment.

This loom makes real lace, imitating hand work. We give a photographic reproduction of a sample of Valenciennes lace made with this machine, also a study of the rounded mesh of Valenciennes from Bruges. The pattern is not the work of a regular designer of lace, but was composed spontaneously by M. Malhère, who invented the loom; this explains its lack of elegance.

It is claimed that this loom can produce all kinds of lace, and that competent judges, and even lace-makers, confound the lace which it produces with that made by hand. The microscope demonstrates to the incredulous that the weaving is the same as hand-made lace, without the least resemblance to the imitation.

For the principal facts we are indebted to the report written on this subject by M. Jousselin, engineer. The report begins by explaining how the inventor was led to construct the machine.

M. Malhere, in studying with a magnifying glass the intertwining of the thread of the lace made by hand, ascertained that in all kinds of lace, in the network and in the flowers, the thread is subjected to the same operation. This was the first conception of the possibility of producing these operations mechanically. Indeed, if one considers a twist forming the mesh of the Valenciennes and the knot of the figure constituting the flower, it is ascertained that the thread No. 1 (Fig. 1) crosses successively over thread No. 2, over thread No. 4 (which was crossed over No. 3), and under No. 3, in order to return, passing over and under the threads until it resumes its original direction, forming thus, with the three other threads, a twist of four threads. In Fig. 2, the adjacent threads, 1 and 2, pass suddenly in a transverse direction, twisting with a half revolution, and passing in alternation over and under threads 3, 4, 5, 6.

This problem, then, is reduced to making a twist of two contiguous threads from right to left or from left to right, according to the requirements of the design, and making it in such a manner that this twisting will be effected at will from right to left or from left to right in order to reverse the thread below or above.

In consequence of this it is necessary to accomplish mechanically the transposition of the threads in order to put in proper relation those threads which are destined to be worked together, and M. Malhere conceived the fundamental idea of making a machine employing rotative disks, which contain two threads capable of being twisted together by a half revolution or a complete revolution. These disks are tangent and in pairs, capable of transferring the thread from disk to disk, and are arranged in the segment of a cylinder, in order that the threads between the disks and their converging point may be as nearly as possible of a uniform length. The lace is produced in the geometrical center of the segmental frame. Several bands of lace are produced simultaneously by the superposition of the thread carriers. M. Malhere has also invented a comb with independent teeth which replaces the pins of the hand lace worker. The movements of the several independent members of this machine are controlled by the Jacquard arrangement of perforated cards. Such is the succession of ideas which led to the invention of the lace loom.

The lace from the spindles of the hand lace-worker is not made like net or imitation lace, by two distinct groups of threads, warp and woof, but by veritable twisting, in the interlacing of which all the threads may concur, following the fancy of the designer.

The interlacing threads are collected and fixed in the central part of the machine (corresponding to the pillow of the hand lace-maker by means of pins. This hand method of making lace suggested to M. Malhere the peculiar form which he has adopted for the frame of his automatic loom. It consists of two concentric cylinder segments supported at a convenient height upon a cast iron table. As all parts of

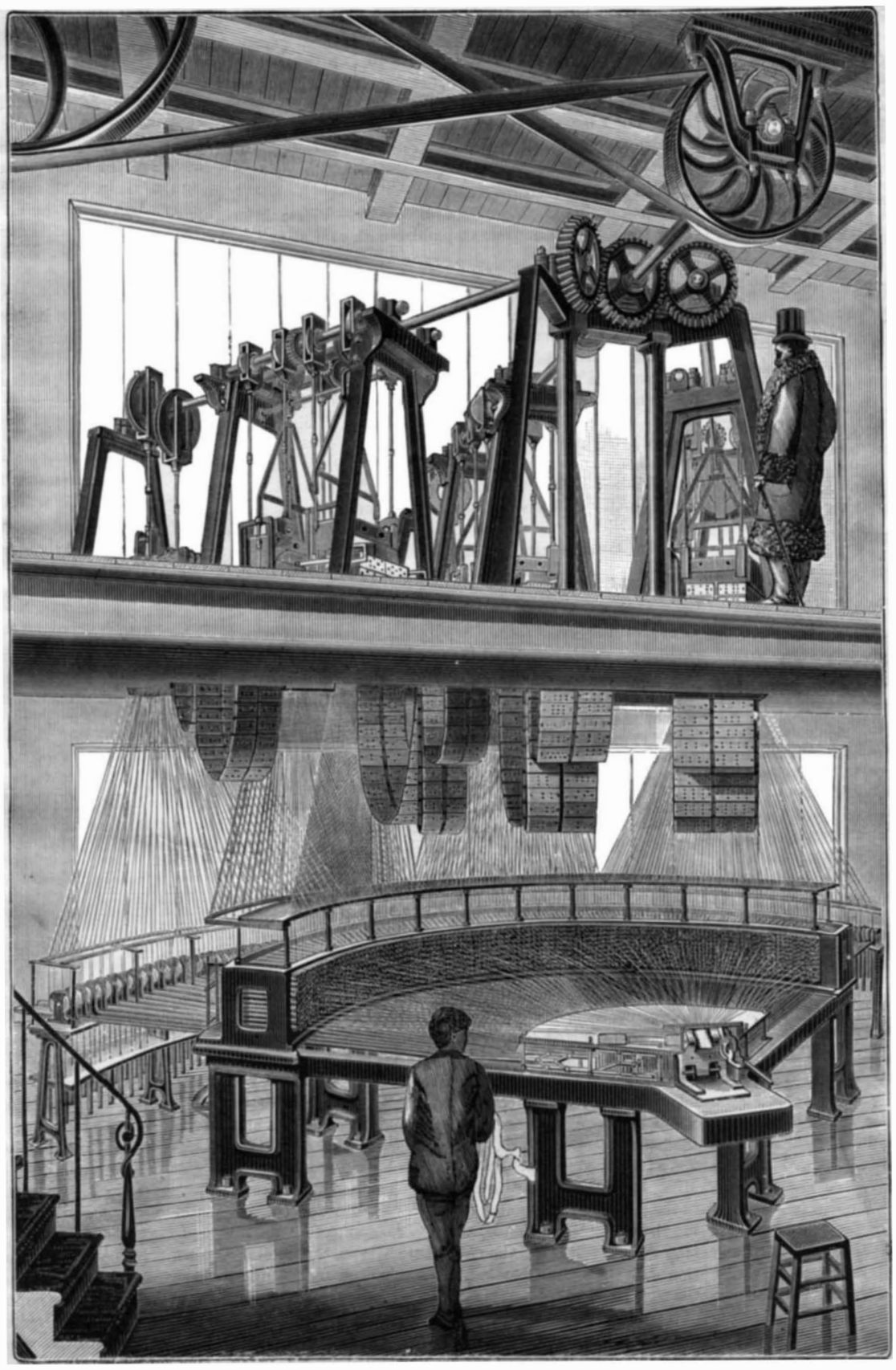

Fig. 5.—MALHERE'S LACE LOOM

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the segmental frame are nearly equidistant from the converging point of the threads, the tension of the thread is uniform, and this arrangement allows each one of the bobbins to circulate in the interior of the cylindrical surface without any displacements of the threads. In the work by hand the lace-maker chooses among the suspended spindles around the drum those that she needs successively; she rolls them between her fingers, either to the right or to the left, in order to twist the threads and interlace them; then she sets the pin which fastens this portion of the mesh, until by another interlacing another mesh is formed, when she withdraws the pins from the portion of the work already finished. Then three kinds of movements are required: A conveying or removal of the selected spindles; rotation of the spindles to the right or to the left; the fixation and displacement of the pins

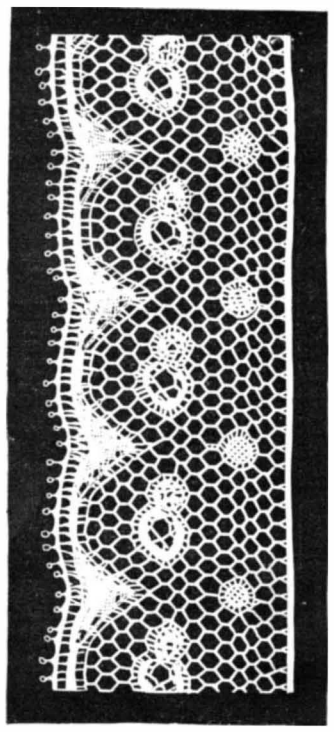

Fig. 3.—Bruges Valenciennes made by the Lace Loom.—From a Photograph.

From what has been said, it will be seen that each thread must work in a manner absolutely independent, and this independence of the different elements constitutes the great difficulty of the mechanical problem.

If one places himself in the center of the Malhere loom, having in front of him the lower segment, it will be seen that this segment is perforated over all its circumference, and that each one of the holes is filled by a metallic cylinder which manipulates the thread, and is operated and controlled by the Jacquard mechanism. According to the piercing of the pasteboard of the Jacquard band, the carriages carrying the bobbins are pushed from the groove of one pin to the groove of another, by little pushers, and may occupy successively all the disks.

In order that the threads leading from the bobbins to the rollers, which occupy the center of the loom, may be interlaced or twisted, the transposition of the bobbins must be by circular motion.

Fig. 4.—Bruges Valenciennes.

An arrangement of rack work and pinions worked by a double chain is controlled by another set of perforated cards, giving an intermittent traction to the chains. This latter Jacquard arrangement is capable of imparting to the cylinders a quarter or half revolution as is needed. We have said that the heads of the pins are tangent in a vertical direction and in a horizontal direction. This construction is not only designed to increase the height of the segments and the number of rows of pins, but to allow the transport of the bobbins from a determined horizontal row into the row situated immediately below or above it. When a bobbin is to be transferred from one row to another, the pins in the Jacquard mechanism corresponding to the motion required cause the pin in the segmental frame to turn a quarter of a revolution only, the sliding groove assuming a vertical position, then the bobbins are moved forward in a vertical direction, and a second quarter revolution of the pin places the bobbin in a horizontal position in such a way as to renew the interlacing of the threads.

The heads of the pins may be compared to the turntable of a railroad. The aim is to remove or add threads, as cars are added or removed in the composition of trains.

The insertion of the retaining pins may be from above or below. The inventor has preferred the latter method, as it furnishes a solid base for the pins and facilitates the removal of the finished fabric. These pins have a lateral and vertical motion.

At the moment that the interlacing of the threads is effected, the retaining pins placed behind and at a little distance from the roller must remain pressed down in order not to interfere with the play of the thread. When the interlacing is accomplished the pin rises in the angle formed by the threads, and the threads are separated by the horizontal movement of the carriages which carry them.

Arriving at a height a little above the upper net of threads, the pin is maintained laterally by a metallic platform, which is traversed over all its surface by radial slots equal in number to the pins, and the lower end of each pin is attached to a slider, moving in a vertical guide, which is capable of moving towards the roller, bringing the pin against the twist previously formed, where it is arrested by a stop, and the pin continues stationary as long as it is necessary to maintain the mesh. In order to release itself and before returning to the point of departure, it falls below the net of threads, in such a way as not to touch them in its retrograde movement. These quadrangular displacements of the pins are effected independently, being controlled by Jacquard mechanism.

Such, in general terms, is the lace loom of M. Malhere which has been recently exhibited in Paris. The apparatus is certainly a masterpiece of mechanism, and is an ingenious conception. The accompanying engraving indicates in some measure the intricacy of the machinery.—*La Nature.*

Bro. Gardner on Labor and Capital.

The Lime-Kiln Club is a facetious creation of the Detroit *Free Press*, and the reports of the imaginary meetings of the club, under the imaginary presidency of Brother Gardner, furnish the readers of the *Press* with perennial supplies of wit. The following is a specimen:

The Secretary read the following:

CHICAGO, March 30, '81.—*Bro. Gardner*—Please inform your friends whether you sympathize with capital or labor, and oblige a

WORKINGMAN.

"In the fust place, dar' am no call for me to sympathize with either," replied the old man in answer. "One am jist as necessary to the odder as two wheels to a wagun. Capital cl'ars away a spot an' builds a factory an' gins fifty or a hundred men a chance to airn a fa'r support fur demselves an' families. Dat factory wouldn't be dar' 'cept fur capital, an its wheels can't move widout labor. If dis' workin' man wanted to draw me out on the question of strikes I has only a word to say. I believe dat de average employer pays his help a f'ar price an' all he kin afford to. I b'lieve he knows his business, an' am mo' competent to run it dan de men who labor fur him. If I can't work fur a man fur de price he offers I stan' aside. If I hire a man I pay him do goin' price, an' I doan' let him tell me dat I mus' do thus an' so. Men strike bekase dey can't dictate, but de same men wouldn't be willin' dat deir employers should dictate to dem how much rent to pay, what close to buy, and how to spen' deir wages. As I said befo' dar am no call fur sympathy in de case. De mo' strikes we have de less money will be put into manufactures. When a capitalist kin loan his money at good interest he am foolish to put it into a factory whar' demagogues kin hariss an' ruin him. Jist you remember what I'm talkin'. De mo' unions de less factories. De mo' strikes de less work. Do you fink I'm foolish 'nuff to take my $800 out'n de bank, whar' principal an' interest am safe as a rock, an' put it into a coopershop, whar' three workmen could sink de hull of it in one strike bekase I couldn't pay mo' fur makin' de bar'ls dan de same would sell fur? Shoo! Fings am comin' to a putty pass when de man wid a shovel on his shoulder kin boss de man whose factory turned out dat identical tool!"

AGRICULTURAL INVENTIONS.

Mr. Bishop L. Smith, of Loogootee, Ind., has patented a riding revolving horse rake for raking stalks, grain, and hay, so constructed that it can be easily and conveniently controlled by the rider.

Mr. Charles S. Giger, of Highland, Ill., has patented an improved harrow, so constructed that either side or the whole harrow can be readily raised from the ground to clear the harrow teeth of trash.

An improved mower and reaper has been patented by Mr. Milan D. Farnam, of Ira Hill, N. Y. The invention consists in the peculiar construction of the mechanism for connecting the cutter bar and shoe, and also for connecting the pitman with the shoe and the cutter bar; also in the combination with the various bearings of mechanism for taking up the wear; and in the combination with the brace or coupling of a mechanism for holding the brace bar and the shoe at the desired distance from the ground.

An improved cultivator has been patented by Mr. Lafayette K. Tipton, of Maysville, Mo. The object of this invention is to furnish a cultivator so constructed that it can be readily adjusted to work deeper or shallower in the ground, that the points of draught attachment can be adjusted directly in front of the centers of resistance, and that the mechanism will not be broken should the plows strike obstructions.

Mr. William J. Powell, of Marshfield, Mass., has patented a cotton harvester, which gathers cotton from the plant while in the field by means of a vacuum.

Mr. John L. Scharff, of Womelsdorf, Pa., has patented a bean pod stringer for removing the string or threads from bean pods, and cutting off the ends of the pods. It consists in three bars, forming a clamp, clamping screw, a block or blocks having a semicircular flange, and a curved knife for removing the strings from the pods.

Mr. Thomas W. Hogsett, of Edray, West Va., has patented an improved churn, which is simple, easily operated, and the working parts of which can be adjusted for the operator while either sitting or standing, and which working parts can be placed aside altogether when the churn is to be cleaned.

Exploration of the Beni River.

The April number of the Kansas City *Review of Science* contains an article by Professor John D. Parker announcing the recent important discoveries by Dr. E. R. Heath in South America. Dr. Heath has solved the problem of the Beni River, and completed in this respect the work of Professor Orton, left unfinished by his untimely death. He has discovered two new rivers, one of which has been named in honor of Professor Orton, and explored the hitherto unknown mouth of the Madre de Dios, which is 2,350 feet wide where it empties into the Beni. The "multitudes of man eating savages," so long believed as existing along the Beni River, proved to be a myth, and the superstitious fear that has so long hung over this portion of the Beni River has been dissipated. He accomplished this perilous exploration in a frail canoe with two Indians, at his own expense. Dr Heath will hereafter be remembered and counted among the discoverers of South America.

The Chagres River Dam.

Late advices from the Isthmus of Panama state that the engineers of the proposed ship canal have sunk a shaft 100 feet deep, where the Chagres River dam is to begin, and have not yet found bed rock. This is not an encouraging sign, as the possible success of the canal hinges on the feasibility of diverting the course of the river by the proposed dam. The dam will have to be over a mile long and 150 feet high. It is proposed to make it 3,150 feet wide at bottom and 780 feet at top, the lake created by it to contain a thousand million tons of water. This is a stupendous project at best; and if the foundations of the dam must be laid more than a hundred feet below the surface, the successful issue of the undertaking to which it is preliminary becomes more than ever problematical.

Correspondence.

A Remarkable Hailstorm in Arkansas.

To the Editor of the Scientific American:

We were visited on the afternoon of April 11 by the most terrific hailstorm ever witnessed in this region. The atmosphere had been oppressive for twenty-four hours, the thermometer reaching 73° Fah. at 2 P.M., and the hygrometer showed the air to be nearly saturated with moisture. About 5:30 P.M. the air was "hot" and suffocating. Two cloud masses appeared moving upon us, the one from the southwest soon presenting the peculiar "boiling," jagged appearance so often noticed in precursors to hail; the other, from the northwest, very black and moving rapidly. A little before the time of meeting the sky overhead was of a livid green color. The first dash of hail was from the west, but the direction of the falling stones was quickly shifted to northwest, and finally almost from due north. It was observed that the stones fell, for the most part, at an angle of not more than 10° or 15° from the vertical, and their effective force indicated a fall from a considerable height. The storm continued about fifteen minutes, and the noise produced was almost deafening. I was able to make some measurements, which will convey a better idea of the size and nature of this hail. One stone measured 7 inches in circumference, and weighed 5·6163 ounces avoir. Six stones showed an average diameter of 2·2 inches, and together weighed 14·119 ounces avoir. Other stones were picked up later which would measure nearly 3 inches in diameter.

The stones were formed by ten to fourteen concentric layers of snow and ice around a single nucleus, the outside layers being chiefly snow, and deeply corrugated. The shape, in many cases, was not spherical, but more like that of an apple, having two flattened and pitted surfaces opposite. The average number of stones found upon the level ground was about 135 per square foot. I hardly need say that the damage has been very great. The iron roofs in the town have been well nigh ruined. The tin roofs fared, in some cases, better, but present very much the appearance of a waffle iron. The destruction of glass has been immense, the heaviest double thick offering no effective resistance. A number of small animals were killed or injured. Men exposed to the storm were badly bruised. Is not this the champion hailstorm of the season? C. P. C.

Fayetteville, Ark., April 13, 1881.

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COFFEE.—ITS USES AND MEDICINAL QUALITIES.

BY HENRY SEGUR, M.D.

Doctor Bock, of Leipsic, says:* "The nervousness and peevishness of our times are chiefly attributable to tea and coffee;" he says that "the digestive organs of confirmed coffee drinkers are in a state of chronic derangement, which reacts on the brain, producing fretful and lachrymose moods. Ladies addicted to strong coffee have a characteristic temper, which may be described as a mania for acting the persecuted saint," etc.

I cannot agree with Dr. Bock that the nervousness and peevishness of the present time are to be attributed to the use of coffee. If people are more nervous or in worse humor now than formerly, we may find other causes arising from the customs and habits of society much more likely to produce such a state of things than the use of this particular article of diet. I have no intention of pointing out many changes and peculiarities in the habits of the age to show many other more prominent reasons for people being in bad humor besides the use of coffee. My object is to defend coffee from a slander aimed at one of our best friends—a friend more likely to relieve the morbid state of things complained of than to produce it. Who that has experienced the good effects of coffee can sit quietly and hear it abused? especially by an estimable physician who has written learned books on the nervous system. The nerves of every honest friend of coffee tremble with the shock of an attack from such a quarter.

Let us examine the effects of coffee on the economy. Taken in moderation it is a mental and bodily stimulant of a most agreeable nature; and, followed by no harmful reaction, it produces contentment of mind, allays hunger and bodily weakness, and increases the incentive and capacity for work, makes man forget his misfortunes, and enables those who use it to remain a long time without food or sleep, to endure unusual fatigue, and preserve their cheerfulness and contentment.

Jomand says: "An infusion made with ten ounces of coffee enabled me to live without other food for five consecutive days, without lessening my ordinary occupations, and to use more and more prolonged muscular exercise than I was accustomed to without any other physical injury than a slight degree of fatigue and a little loss of flesh."

The mental exhilaration, physical activity, and wakefulness it causes, explain the fondness for it which has been shown by so many men of science, poets, scholars, and others devoted to thinking. It has, indeed, been called "the intellectual beverage."

It supported the old age of Voltaire, and enabled Fontenelle to pass his hundred years.

The action of coffee is directed chiefly to the nervous system. It produces a warming, cordial impression on the stomach, quickly followed by a diffused, agreeable nervous excitement, which extends itself to the cerebral functions, giving rise to increased vigor of imagination and intellect, without any subsequent confusion or stupor, such as are characteristic of narcotics.

Coffee contains essential principles of nutrition far exceeding in importance its exhilarating properties, and is one of the most desirable articles for sustaining the system in certain prostrating diseases; as compared with the nutrition to be derived from the best of soups, coffee has decidedly the advantage, and to be preferred in many instances.

Liebig says: "We shall never know how men were first led to the use of coffee, but that we may consider the article so remarkable for its action on the brain and the substance of the organs of motion, and as an element of food for organs as yet unknown, which are destined to convert the blood into nervous substance, and thus recruit the energy and the nervous moving and thinking faculties."

The medicinal effects of coffee are very great. In intermittent fever I have used it with the happiest effect in cutting short the attack, and if properly managed is better in many cases than the sulphate of quinine. In that low state of intermittent, as found on the banks of the Mississippi River and other malarial districts, accompanied with enlarged spleen and torpid liver, when judiciously administered it is one of the surest remedies. In these cases it should be given in decoction made with four ounces of well roasted and ground coffee, boiled in a quart (16 ounces) of water in a covered vessel, down to half a pint (4 ounces), and two tablespoonfuls given hot every two hours, commencing six hours before the expected attack, and keeping the patient well covered in bed.

It has been found that in typhus fever coffee increases the elimination of urea, and so far purifies the blood without increasing the destructive metamorphosis of tissue, and that it lessens coma and low delirium.

In yellow fever, from a long experience, I consider coffee as my chief reliance, after other necessary remedies have been administered; it restrains tissue change, and thus becomes a conservator of force, in that state in which the nervous system tends to collapse, because the blood has become impure; it sustains the nervous power until the depuration and reorganization of the blood are accomplished, and has the advantage over other stimulants in inducing no injurious secondary effects.

In spasmodic asthma its utility is well established, whooping cough, stupor, lethargy, etc.

In the hysterical attacks of some females, for which the physician can form no diagnosis or cause for the peculiar and eccentric symptoms manifested; a screaming, crying, staring, kicking patient, with no coherent answer for the medical adviser, at the same time with an evident tendency to act the persecuted saint—give her a cup of well made, strong, black coffee, she becomes quiet, revives, smiles benignly, as if she had swallowed a panacea that had suddenly delivered her from the clutches of the imps of Satan and wafted her from all the miseries of a condemned and tortured spirit to the Elysian fields of Houris.

We have used it as a remedy in croup, diphtheria, nephritis, chronic dirrhea, etc. In poisoning from opium it is well known as the best remedy, and always on hand.

Hayne says: "That in a case of violent spasmodic disease, attended with short breath, palpitation of heart, and a pulse so much increased in frequency that it could scarcely be counted, immediate relief was obtained from a cup of coffee, after the most powerful antispasmodics had been used in vain for several hours," etc.

After a hearty meal a cup of coffee will relieve that sense of oppression so apt to be experienced, and enable the stomach to perform its offices with comparative facility.

In fact, coffee carries healing on its wings. It is opposed to malaria, to all noxious vapors; as a disinfectant it has wonderful powers; as an instantaneous deodorizer it has no equal; for the sick room, the fetid odors arising from cutaneous exhalations are immediately neutralized by simply passing a chafing dish with burning coffee grains through the room.

It may be urged that an article possessing such powers and capacity for such energetic action must be injurious as an article of diet of habitual employment and not without deleterious properties; but I have never noticed any corresponding nervous derangement after its effects have disappeared, as is seen in narcotics and other stimulants. The action imparted to the nerves is natural and healthy, and I must positively deny that the habitual use of the article is injurious.

Habitual coffee drinkers generally enjoy good health and live to a good old age. Some of the oldest persons I have ever known have used it from earliest infancy without feeling any depressing reaction, such as is produced by alcoholic stimulants.

In Porto Rico our fairest part of creation, at the tenderest age, have been induced to forget the delicious draught from the maternal fountain by the substitution of a decoction of coffee, which soon becomes the daily beverage.

Mayaguez, Porto Rico, 1881.

* SCIENTIFIC AMERICAN, September 6, 1879.

What is the Legal Fence?

The Indianapolis *Journal* has taken pains to gather information as to the laws regarding the fencing of railroads in sister States. In Massachusetts the legal fence is four feet high. A "sufficient barrier" only is demanded, whether the equivalents be furnished by streams, ditches, live growths, or constructions in wood, stone, or other material. Vermont and Connecticut legal fence is five and a half feet high, with provisions essentially as above. In Maine and New Hampshire the legal fence is four feet high; Rhode Island, stone or wood fences must be four and a half feet high; hedges and ditches are elaborately described.

New York.—The town meetings prescribe what shall be deemed a legal fence in each town. Assessors and commissioners of highways perform the duties of fence viewers. Four and a half feet is the usual height prescribed.

Pennsylvania.—Towns and counties secure special legislation for fencing railway lines, and to prevent running of the stock at large.

New Jersey.—Fences are to be four feet two inches high, of wood, brick, or stone, and four and a half feet if of other materials.

Delaware.—Four feet, with a ditch within two feet, is a lawful fence. Wood or stone fences, or hedge, four and a half feet high.

Maryland, Virginia, North Carolina, Georgia, Florida, Alabama, Arkansas, Tennessee.—Legal fences five feet high.

West Virginia.—Legal fences four and a half feet high.

South Carolina.—Fences must be six feet high, of wood or hedge, or ditches equivalent as barriers.

Missouri.—Hedge five feet, fence four and one half feet.

Kentucky.—"All sound or strong fences five feet high, so close that stock cannot creep through," is the definition of the legal fence.

Ohio.—"A fence, of whatever material, constructed in all respects such as good husbandmen ought to keep." Statute of 1865.

Illinois.—"Fences four and one half feet high, of whatever material the fence viewers shall deem sufficient."

Michigan.—"Fences four and one half feet high of rails, timber, boards, stone, or other things deemed equivalent thereto in the judgment of fence viewers."

Wisconsin.—"Fences four and one half feet high," etc. By act of April, 1878, barbed wire fence is defined as a legal fence.

Minnesota.—"Fences four and one half feet high," etc. Barb fence defined by the act of 1877.

Iowa.—"Four and one half feet high, or fifty-four inches." Barbed wire fence prescribed as legal fence, 1876.

Texas.—"Five feet high." Barbed wire defined as legal fence.

Kansas.—"Worm fences four and one half feet; turf, four feet with ditches; wire fence, posts twelve feet apart."

Nebraska.—The legal fence is described as "such a fence as good husbandmen generally keep."

California.—The legal fence is described with great particularity. Wire, post and rail, brush, picket; ditch and pole and hedge wire rences, not less than three separate strands, the first eighteen inches from the ground, the others two and one foot apart.

Colorado, Arizona, Montana, and Utah.—Four and one half feet high.

New Mexico, Idaho, and Washington.—Four feet high.

In Washington Territory barbed wire fence must carry a top rail of wood.

Indiana.—Any structure in the nature of a fence, such as good husbandmen generally keep.

Tobacco Smoke.

In further research on this subject Dr. LeBon finds that collidine, the new alkaloid existing in tobacco smoke (with other aromatic principles, and prussic acid, as well as nicotine), is a liquid of agreeable and very penetrating odor, and as poisonous as nicotine, the twentieth part of one drop sufficing to paralyze and kill a frog. It is the prussic acid and various aromatic principles that cause headache, giddiness, and nausea in smoking certain tobaccoes that contain little nicotine. Other tobaccoes, rich in nicotine, have no such effects. The tobaccoes containing most prussic acid and collidine are those of Havana and the Levant. The dark semi-liquid matter which condenses in pipes and cigar-holders contains all the substances just named, as well as carbonate of ammonia, tarry and coloring matter, etc. It is very poisonous; two or three drops of it will kill a small animal. The combastion of tobacco destroys but a small part of the nicotine, and most of this appears in the smoke. The proportion absorbed by smokers varies according to circumstances, but hardly ever falls below 50 centigrammes per 100 grammes of tobacco burnt. About the same quantity of ammonia is absorbed at the same time. Naturally, more of the poisonous principles are absorbed where the smoke is breathed (as in a room); less in the open air. A frog placed in a receiver containing a solution of nicotine, with about one drop of that substance to a little of water, succumbs in a few hours. Tobacco smoke contains about 8 milliliters of carbonic oxide per 100 grammes of tobacco burnt. The poisonous properties of tobacco smoke are not due to this gas, as has been maintained in Germany.

The Absorption and Scattering of Heat by Leaves.

In order to rightly understand the *role* of heat in the growth of plants, it is important to know what part of the heat rays which strike the leaves is absorbed by them, what part is thrown back and scattered, and what part passes through them to lower organs. An inquiry of this nature has been recently made by M. Maquenne. Of his method we will merely say that he used as constant heat source a Bourbouze lamp (in which a platinum wire is kept glowing by a regulated mixture of coal gas and air); and for some experiments with low temperatures he employed Leslie's cubes. The results of the research are briefly as follows:

1. All leaves scatter a part of the heat they receive vertically to their surface; with the Bourbouze lamp this diffusion is about 0·25 of the whole heat, with a Leslie cube a small percentage.

2. Generally the under side scatters more than the upper, but the reverse sometimes occurs.

3. Leaves absorb a good deal of heat from the Bourbouze lamp, the absorption being due to the presence of absorbing substances, especially chlorophyl and water, in the tissue, and to the diffusion taking place internally at the surface of each cell; it is generally greater at the upper side than at the lower.

4. Thick leaves absorb more than thin leaves.

5. The absorptive power of leaves for the heat of boiling water is very nearly equal to that of lampblack.

6. Leaves let heat pass through better the thinner or younger they are.

7. The radiating power of leaves with a great excess of temperature is pretty near that of lampblack; it decreases a little when the inclination increases.

8. The absorptive power of chlorophyl is, on an average, equal to that of water for rays of the Bourbouze lamp, and increases proportionately to withdrawal, in one direction or the other, from the heat *maximum*.

Lime in Agriculture.

All writers on agricultural subjects seem to agree that the use of lime on clayey soil is of great benefit, crops thus treated showing the advantage of its mixture with the soil. A correspondent to the *Farmer's Review* writes from France that the European farmers coincide with our agriculturists in this respect, and concludes as follows:

The extending use of lime is excellent for clay soils. Argil augments in volume when moist—diminishes when dry. Carbonate of lime possesses neither of these properties; applied then to cold clay soils it enables the air and heat to penetrate more readily, thus making the land friable. On light soils the action of lime is weak, and on those very light the use of lime is misplaced. But as the action of lime rapidly transforms the nutritive capital of the land, its success cannot be permanent unless rationally supplemented by direct fertilizers, as farm yard manure, etc. Hence, the adage, Lime enriches the father, but ruins the children. If the soil have an excess of acids, lime "sweetens" by neutralizing them; all cultivated soils are slightly acid, such being necessary for vegetation. Too much, however, acts directly on plants, and indirectly by the formation of soluble and noxious salts of iron.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

The Medart Pat. Wrought Rim Pulley. See adv., p. 284

Gardiner's Pat. Belt Clamp. See illus. adv., p. 285.

Light Tramway Engines, flexible wheel-base, wood or iron rails. Address W. A. Gilday, 54th St., Phila., Pa.

German Corn Remover will allow nicer fitting boots. Take no other. Sold by druggists. 25 cts.

Grain Nickel, Nickel Anodes Rolled or Cast, Nickel Salts. Greene, Tweed & Co., 118 Chambers St., N. Y.

For Sale.—Two Locomotive Boilers, by Danl. W. Richards & Co., 92 Mangin St., New York.

If your brain is overtaxed, use Van Beil's "Rye and Rock." It forms carbon.

Cutters for Teeth of Gear Wheels formed entirely by machinery. The Pratt & Whitney Co., Hartford, Conn.

Portable Railway Track and Cars. Contractors, Planters, Miners, send for circulars. Francis W. Corey & Co., 5 & 7 Dey St., New York; 95 Washington St., Chicago, Ill.

Why be tortured with hard or soft corns? German Corn Remover cures every time. For sale by all druggists

Emery, Glue, Composition, Pumice, and all Goods for Polishing Metals. Greene, Tweed & Co., New York.

Essay on Inventions.—What qualities will make them profitable, and how to incorporate these qualities in inventions. 25 cts. postpaid. Address N. Davenport, Valparaiso, Ind.

Second-hand Lathes, Planers, Boring and Turning Mills, good as new, for sale cheap. Apply to Barbaroux & Co., Louisville, Ky.

For the best Jig Saw Blades, go to Wm. Cuddy, 108 Hester St., New York.

If your boiler foams, it is caused by impurities suspended upon the surface of the water. It is a foul proceeding, and can be entirely obviated by the Hotchkiss Mechanical Boiler Cleaner. 84 John St., New York.

Improved Skinner Portable Engines. Erie, Pa.

"Rival" Steam Pumps for Hot or Cold Water; $32 and upward. John H. McGowan & Co., Cincinnati, O.

Skinner's Chuck. Universal, and Eccentric. See p. 268.

Safety Boilers. See Harrison Boiler Works adv., p. 252.

Inventors sending a three cent stamp to Inventors' Institute, Cooper Union, New York city, will receive a copy of the *Industrial News* free.

The Eureka Mower cuts a six foot swath easier than a side cut mower cuts four feet, and leaves the cut grass standing light and loose, curing in half the time. Send for circular. Eureka Mower Company, Towanda, Pa.

The Newell Universal Mill Co., Office 7 Cortlandt St., New York, are manufacturers of the Newell Universal Grinder for crushing ores and grinding phosphates, bone, plaster, dyewoods, and all gummy and sticky substances. Circulars and prices forwarded upon request.

Pure Oak Leather Belting. C. W. Arny & Son, Manufacturers, Philadelphia. Correspondence solicited.

Jenkins' Patent Valves and Packing "The Standard." Jenkins Bros., Proprietors, 11 Dey St., New York.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

The "1880" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 262 Dover St., Boston, Mass.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited. Erie, Pa.

Power, Foot, and Hand Presses for Metal Workers. Lowest prices. Peerless Punch & Shear Co. 52 Dey St., N.Y.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N. Y.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Clark Rubber Wheels adv. See page 236.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

For the Cheapest Process of Manufacturing Bricks, see Chambers Bros. & Co.'s adv., page 254.

Cope & Maxwell M'f'g Co.'s Pump adv., page 252.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 252.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p.252.

For Thrashing Machines, Engines, and Horse Powers, see illus. adv. of G. Westinghouse & Co., page 253.

The I. B. Davis Patent Feed Pump. See adv., p 269.

Moulding Machines for Foundry Use. 33 per cent saved in labor. See adv. of Reynolds & Co., page 269.

The Sweetland Chuck. See illus. adv., p. 269.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Soloman's Parallel Vise, Taylor. Stiles & Co., Riegelsville, N.J.

For best Duplex Injector, see Jenks' adv., p. 269.

The American Electric Co., Proprts Mfrs of Thompson Houston System of Electric Lighting the Arc Type.

See Bentel, Margedant & Co.'s adv., page 285.

Clark & Heald Machine Co. See adv., p. 286.

For the best Diamond Drill Machines, address M. C. Bullock, 80 to 88 Market St., Chicago, Ill.

Blake "Lion and Eagle" Imp'd Crusher. See p. 284.

Diamond Planers. J. Dickinson, 64 Nassau St., N. Y.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

50,000 Sawyers wanted. Your full address for Emerson's Hand Book of Saws (free). Over 100 illustrations and pages of valuable information. How to straighten saws, etc. Emerson, Smith & Co., Beaver Falls, Pa.

Peerless Colors—For coloring mortar. French, Richards & Co., 410 Callowhill St., Philadelphia, Pa,

See Special Bolt Forging Machine Notice, page 300.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p.284.

For the manufacture of metallic shells, cups, ferrules, blanks, and any and all kinds of small press and stamped work in copper, brass, zinc, iron, or tin, address C. J. Godfrey & Son, Union City, Conn. The manufacture of small wares, notions, and novelties in the above line, a specialty. See advertisement on page 253.

Elevators, Freight and Passenger, Shafting, Pulleys and Hangers. L. S. Graves & Son, Rochester, N. Y.

For all kinds of Special Rubber Goods, address Akron Rubber Works, Akron, O.

Gear Wheels for Models (list free); Models, Experimental Work, etc. D. Gilbert & Son, 212 Chester St., Philadelphia, Pa.

Gould & Eberhardt's Machinists' Tools. See adv., p. 284.

For Heavy Punches, etc., see illustrated advertisement of Hilles & Jones, on page 284.

Comb'd Punch & Shears; Universal Lathe Chucks. Lambertville Iron Works, Lambertville, N. J. See ad. p.253.

Reed's Sectional Covering for steam surfaces; any one can apply it; can be removed and replaced without injury. J. A. Locke, & Son, 40 Cortlandt St., N. Y.

4 to H. P. Steam Engines. See adv. p. 286.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 285.

Long & Allstatter Co.'s Power Punch. See adv., p. 285.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

Rowland's Vertical Engine. Wearing parts of steel. Broad bearings. F.C.& A.E.Rowland, New Haven, Conn.

The only economical and practical Gas Engine in the market is the new "Otto" Silent, built by Schleicher, Schumm & Co., Philadelphia, Pa. Send for circular.

Tyson Vase Engine, small motor, 1-33 H. P.; efficient and non-explosive; price $50. See illus. adv., page 284.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 285. Totten & Co., Pittsburg.

Use Vacuum Oil Co.'s Lubricating Oil, Rochester, N.Y.

Lightning Screw Plates and Labor-saving Tools, p. 286.

Good Machinists and Vise Hands wanted. Address Watertown Steam Engine Company, Watertown, N. Y.

Catechism of the Locomotive, 625 pages, 250 engravings. The most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for a catalogue of railroad books. The Railroad Gazette, 73 Broadway, New York.

Eclipse Fan Blower and Exhauster. See adv., p. 285.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) E. L. asks: Which is the strongest acid, HNO_3, H_2SO_4, or HCl? Please state their respective strengths. A. If you mean which acid most rapidly corrodes or dissolves metals, a mixture of nitric (HNO_3) and hydrochloric (HCl) acids (aqua-regia—HCl 3, HNO_3 1) would head the list, followed by nitric, hydrochloric, and sulphuric acids. Hydrochloric (cold) acid does not attack silver, yet it decomposes a solution of that metal in nitric acid, forming silver chloride. Sulphuric acid does not attack lead, yet it is capable of decomposing the nitrate or chloride of that metal to form a sulphate.

(2) C. H. L. asks how to make white writing ink. A. Triturate together 1 part of honey and 2 parts dry ammonia alum, dry thoroughly, and calcine in a shallow dish over the fire to whiteness. Cool, wash, and rub up with enough gum water for use. Pearl white (nitrate of bismuth) may be used in a similar manner.

(3) J. S. T. asks how to make a good drier for printer's ink. We frequently get ink, especially job ink, that is off set; can hardly handle the work. If drier is not what it needs, please state what it does need. A. A small quantity of perfectly dry acetate of lead or borate of manganese in impalpable powder will hasten the drying of the ink. It is essential that it should be thoroughly incorporated with the ink, by trituration in a mortar.

(4) W. J. B. asks for a receipt for making a gum to attach muslin to leather. I think the sample sent is made of gum arabic, but I am not positive. A. The gum on your samples is gum dextrine or British gum, a commercial article. It is simply dissolved in hot water to mucilaginous consistence, applied with a brush and allowed to dry.

(5) J. P. M. asks: Which do you consider best for the arch of press, a heavy cast iron one or a lighter one of cast steel, malleable iron or a wrought iron forging? A. Use steel or wrought iron. They will spring under the pressure and not break.

(6) G. A. W. asks: 1. How can I get the manganese oxide out of some coke, which I had in a Leclanche battery? A. Coarsely powder and wash in a gentle stream of water. With care the lighter coke may be washed away from the heavier oxide. 2. Can you refer me to a paper which describes the ice machine? A. See "Ice Making and Ice Machines," SUPPLEMENTS 85 and 91.

(7) J. C. B. asks: What composition is used in the manufacture of articles made of sawdust, for holding the particles together? A. Blood, or blood freshly mixed with a little finely powdered lime. Weak glue size has also been used with sawdust in a similar manner. The articles are moulded under heavy pressure.

(8) D. Bros. ask: Can you inform us where to get some red indelible ink to use with stamps on linen? A. Liquefy 1 pint of balsam of capivi by aid of heat, and gradually stir in 2 ounces of thoroughly dry white curd soap, cut in thin shavings, and stir until properly diffused. Then introduce a sufficient quantity of vermilion, and stir occasionally until cold. This ink is suitable for stamps.

(9) J. H. W. asks: 1. Please give some formula by which I can prevent the fungus growths on cedar trees. A. Wash the trunks occasionally with lime water. 2. How can I cheaply extract nitrogen from the air and hydrogen from water? A. Pass dry air slowly through granular charcoal heated to redness in an iron tube, then through several copper tubes containing red hot oxide of copper, then over dry slaked lime. The hot carbon forms carbonic acid and carbonic oxide with the oxygen of the air; the carbonic oxide is converted into carbonic acid by the oxide of copper, and the carbonic acid is absorbed by the lime leaving nearly pure nitrogen. Pass steam through a large quantity of red hot iron turnings; a portion of the steam is decomposed by the hot iron. The hydrogen resulting may be collected in a reservoir with the unchanged steam, the latter condensing on cooling. 3. If hydrogen is compressed to one-half its natural volume will it be one-fourth as light as air or one-seventh? A. About one-seventh as heavy.

(10) R. T. asks: Which are the best acids for tin, lead, and antimony, or an acid for a composition of these three metals together? A. A warm mixture of 1 part nitric and 3 parts hydrochloric acid will dissolve these metals with the greatest facility.

(11) A. R. writes: Having broken my 17x21 glass bath from top to bottom (the zigzag or center lines show the breakage), I would like to know if you have any sure means of cementing it together. I have thought of gutta percha, but as this should be put on hot, I am afraid that parts would get cool. I have also thought of this stratena cement. Would it resist nitric acid? A. Dissolve shellac in alcohol enough to form a liquid of the consistence of molasses. Clean the parts dry, smear them with this, press the parts firmly together, and allow to remain under pressure twenty-four hours; then coat the inside over the joint with a strong solution of gutta percha in benzole, and let it harden before wetting. The shellac solution should be perfectly smooth and free from lumps.

(12) E. L. H. asks: How can a physician's thermometer be tested to know if it is correct? A. Only by comparison with the indications of a standard thermometer under similar circumstances.

(13) R. H. C. asks: What is the proper temperature for an incubator? A. 104° Fah.

(14) R. H. B. writes that A. S. R. will find on page 57, vol. xli., SCIENTIFIC AMERICAN, an elaborate article on the "Manufacture of Indian Arrowheads," by F. H. Cushing.

(15) A. S. writes: We have standing throughout our factories water barrels in case of fire. The water in these, after long standing, becomes offensive, and I should judge unhealthy. Will you please tell me what preparation put in fresh water will keep the water sweet for any length of time? A. The solution of a quarter pound ordinary green copperas (sulphate of iron) in each barrel of water is recommended.

(16) E. H. asks: Is it necessary to have the brass tubing or condenser of a steam yacht tinned? If so, how is it done? A. It is better to have them tinned. You can purchase them already tinned much better and cheaper than you can do it yourself.

(17) H. E. asks: Will polished steel plated by being immersed in a solution of sulphuric ether and gold chloride last long? A. The film of gold deposited in this way will not wear as well as an electro deposit. See page 116 current volume.

(18) E. D. V. writes: You recently advised to use No 30 copper wire for acoustic telephone. My experience suggests otherwise, and I submit it. No. 22 is generally sold for this use. On a very short line No. 30 would answer, but on lines of usual length it will break too easily between supports, and too many supports interfere with the transmission of sound. On a line of 3,600 feet I use No. 22, and six supports between the terminal ends; that is, supports are 500 feet apart. The wire has stood for four years, worked well, and no breakage. No. 30 would not do at all. I have tried many varieties of telephone—wood, metal, leather, and cloth for diaphragm; steel, iron, and copper wire. No. 22 copper wire, and wood diaphragms, one-sixteenth inch thick and 3 inches diameter, make the best combination. Chamois skin for longest lines makes best diaphragm, but it soon needs replacing. Steel wire produces too much roaring.

(19) R. B. writes: About two years ago I put down in my well a double cylinder pump. The hose at the end of the suction pipe is 18 feet from the pump (water level only 6 feet). The water has to be forced 75 feet high in a tank which is 12 feet above the well and ground level. The suction pipe is 3 inches, delivery pipe 2½ inches, each cylinder of pump 4 inches diameter, stroke 8½ inches. The pump worked well for six months, but since then has worked by fits and starts; that is, it will work for half an hour, and suddenly stop forcing water; it always draws water as high as the pump, but will not force it up. I have had some of the best pump fitters at work at it and they can do nothing. There is no leak whatever anywhere; all joints are tight. The pump is worked by a three horse power horse wheel. Can you or any of your correspondents say why the pump will not work, and what I should do to get it to work? A. There is probably some defect in the delivery valves which permits the water to fall back into the pump on the return stroke.

(20) C. B. C. asks for a receipt for making ink fireproof, and also one for making paper fireproof. A. We know of no means by which ordinary paper may be made practically fireproof. Paper made of pure asbestos fiber resists a high temperature without material alteration. An ammoniacal solution of nitrate of silver, colored with a little India ink, will preserve a legible copy when written with on such paper and subjected to strong heat. Ordinary writing inks cannot be made fireproof.

(21) G. C. F. asks: 1. Is pulverized raw lime better than burned slaked lime as a fertilizer? A. The old slaked lime is best. 2. How much pressure can be produced at the bottom of 1,000 feet of tubing in an artesian well by a rotary pump with a cylinder one foot in diameter run at 200 revolutions per minute pumping air? A. The limit to the pressure would depend entirely upon the perfection of the pump and of the joints and connections of the pipe.

(22) H. B. S. Co. writes: We have two steam pumps running at our store for the purpose of exhibition. They pump Schuylkill water from a tank in the cellar and return it to the same tank continuously. The water, although in constant circulation during the day, becomes very offensive. We have been unable to correct the trouble with lime, etc. Please suggest something that will keep it sweet and harmless, without injuring the working parts of the machinery. A. A small quantity of copperas (ferrous sulphate) will not injure the pumps and will deodorize the water.

(23) A. P. H. asks (1) for a receipt for a good harness blacking oil. A. Melt together 2 oz. asphaltum and 3 oz. beeswax; remove from the fire and add ½ oz. fine lamp black and ½ dr. of Prussian blue in fine powder; then reduce to a thin paste with neatsfoot oil.

(24) P. P. writes: I have several hundred pounds of metal, principally lead, with some tin and antimony, which comes from a smelter but is not refined, and therefore does not run freely. Can you tell me of a cheap process to accomplish this, or will you name some work from which I may obtain the desired information? A. Melt and heat the metal nearly to redness in No. 2 well annealed sand pots, and for every 10 lb. metal stir in (gradually) about 6 oz. dry nitrate of soda. Cool somewhat and skim off the dross before pouring. Save the latter for reduction, as it contains much lead oxide, beside stannic and antimonic oxides.

(25) E. E. P. asks how to dissolve isinglass. A. If you mean fish gelatin, dissolve in hot water, after soaking over night in a little cold water. Mica, sometimes improperly called isinglass, cannot be dissolved without decomposing it.

(26) A. G. B. asks how to make ammoniated opodeldoc. White soap, cut in small shavings, 2 lb.; camphor, 5 oz.; oil of rosemary, 1 oz; oil of origanum, 2 oz.; wine spirit, 1 gallon. Heat over a water bath until solution is effected, cool somewhat, strain, and add 11 oz. ammonia water. Bottle and stopper immediately.

(27) R. G. asks for a receipt for making a paint for roofs, etc., composed of coal tar or pitch, and ground slate or oxide of iron. A. Melt in a capacious iron vessel for at least four hours, 28 lb. each common pitch and asphaltum; then gradually stir in 20 lb. of finely powdered and dry iron oxide or red ocher, and continue the heat another hour or until a drop of the mixture on cooling rolls up very hard. Then remove from the fire, let cool somewhat, and stir in gradually (to avoid accident) a sufficient quantity of good benzine.

(28) J. C. B. asks: Has the question of the formation of ice been conclusively settled, that is, whether it forms on the upper or lower surface? A. Ordinarily ice forms at the surface of water. On cooling, water contracts in volume—becomes denser—until it reaches a temperature of about 39·2° Fah.; if cooled below this point it gradually expands—becomes lighter—until at about 32° Fah., it congeals. Water chilled at the surface contracts and sinks, the warmer and lighter water rising to the surface. This continues until the whole body of water is chilled to 39·2° Fah. From this point to 32° the colder water remains at the surface and there congeals. In shallow and turbulent water ice sometimes forms at the bottom, and, becoming attached to stones, rocks, etc., does not rise. See answer to D. M., page 202 (21), current volume.

(29) D. S. writes: In the construction of wrought iron cylinders, as the flues or shell of a boiler, what is the correct rule for the shrinkage, or, in other words, how much is allowed for the bending of the iron over and above the circumference of a given circle? For instance, for a shell 60 inches diameter, ⅜ inch thickness of iron, how many inches of iron will it take to form the above? A. If the iron is laid out correctly for 60 inches diameter inside, it, is supposed that in the bending the outer part of the plate will draw or stretch to its proper length.

(30) R. L. S. asks: 1. Can you give me a solution that will take the taste out of pine wood vessels? A. Washing with hot dilute hydrochloric acid (acid 1, water 3) will in a measure effect this. They should be thoroughly washed with hot water after this treatment. 2. Have you a receipt for making a paste that will make labels stick on a polished surface for any length of time? A. See answer to R. S., page 203 (26), current volume; also cements, SUPPLEMENT, No. 158. 3. Is there any method, besides sealing air tight and

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drying, for preserving fruits so they will keep in any climate? A. There is no other practical method, we believe.

(31) W. M. L. asks (1) if there is any way by which a large tower bell that is cracked can be mended so as to be serviceable and also sound well. If so, how? A. A mode that will improve (but not restore) the tone of a cracked bell is, to drill a small hole at the extremity of the crack and make a saw cut the whole length of the crack. 2. What is the best compound for setting iron posts in stone? A. Salammoniac (powdered), 2 oz.; flowers of sulphur, 1 oz.; iron borings (free from oil), 5 lb.; water, q. s. to moisten.

(32) C. T. W. asks: 1. What is the horse power of a steam engine, cylinder 2 inches bore by 4 inches stroke, with 60 lb. of steam in the boiler, and running at the rate of 200 revolutions per minute? A. About two-thirds of one horse power. 2. What size boiler is needed for the same? A. A boiler with 25 square feet heating surface. 3. If such an engine be made to run the largest possible electric machine, how many lamps would the machine supply? A. One, and possibly two. With small machines and small power, electric lighting is not economical. 4. What is the candle power of an ordinary Edison lamp, such as is used for lighting dwellings? A. About 16. 5 How many candle power would be required to properly light a room 26 feet long by 17 feet wide by 13 feet high? A. 100 would do it well.

(33) W. B. A. writes: A firm in this city use three boilers in one battery, set in brick work the usual way. They now intend to do away with the water line, tile, and back plates, put cast iron arches over the top, and fill with brick, leaving the boilers naked and exposed to the action of the fire. The boilers are 25 feet by 42 inches, 4 flues; have been in use about eight years, and fired hard. Do you think this a safe plan, and is there any benefit to be gained by so doing? A. It will be liable to injure the boilers and may lead to accident. 2. If the fire flue of a Cornish return flue boiler be 24 inches diameter and 16 feet long, working pressure 100 lb., what kind of iron should be put in the flue? A. Half-inch or nine-sixteenth inch thick, and should have strengthening rings.

(34) H. T. asks how to make dynamite. A. Dynamite is prepared by mixing infusorial silica (a fine silicious sand resembling tripoli) with about 75 per cent of nitroglycerine, which it readily absorbs. It is exploded by percussion priming. See answer to F. & S., page 202 (3), current volume.

(35) R. I. M. asks: 1. Will coke injure a boiler? A. No. 2. How can I prevent coke from clinkering? A. Pure coke will not clinker, there must be some impurity in your coke. It might be beneficial to burn it at a lower temperature.

(36) R. H. M. asks if the linear expansion of thick iron is greater than that of small wires. A. No. 2. What would be the probable linear expansion of one-eighth inch wire 100 feet in length? A. Iron wire for an increase of temperature of 180° expands $\frac{1}{515}$ of its length. 3 Does expansion in length cause corresponding contraction in thickness? A. No. 4. Does contraction and expansion cause displacement of molecules? A. No permanent displacement, unless the iron is under strain. 5. Is there a point in temperature where heat and cold cease to expand and contract iron? A. No such point has been discovered.

(37) J. H. H. asks: 1. How much bituminous coal is required under a tubular boiler to evaporate one gallon water? A. With a good boiler you should evaporate from three-quarters to one gallon of water per pound of coal. 2. What power would be required to put the water at 60 horse power into boiler at 90 lb. pressure to the inch. Does it require more power to put in water at 200° to 212° than at 75° Fah.? A. It does not require more power at 200° than at 75°. To determine the power required we must know the quantity of water to be delivered in a given time.

(38) J. F. S. asks: Does the piston in engine driving machinery stop while the machinery is in motion? A. Yes, it stops twice every revolution of the crank.

(39) A. H. H. asks: 1. Can anything be done to apple trees, the bark having been eaten off above the ground by rabbits? A. Wrap with common gunny or jute bagging and whitewash. 2. Can you give me a composition for welding cast steel at a low heat, which will be cheap and more efficient than borax, and what is the philosophy of its action? A. Try the following: Fuse together in a crucible, at a quick heat, borax, 2 parts; potassium chloride, 3 parts; boracic acid, 1 part; cool and powder. It melts at a low redheat and readily dissolves iron oxide, thus cleaning the metal.

(40) H. L. writes: On our line shaft is a pulley 42 inches in diameter, fastened by set screws, which supplies power to our exhaust fan. These set screws are constantly slipping, and I propose to reduce strain on them by substituting a smaller pulley on line shaft, and interposing a counter shaft geared so as to give same speed to exhaust as before change. Please inform us through your paper if this arrangement will reduce strain on set screws holding driving pulley to line shaft or not? A. It will not reduce the strain on the set screws, if the fan runs at the same velocity. It is the resistance of the fan that determines the strain on the set screws, and not the mode of belting or gearing. Better slot your wheel, put a key seat in your shaft, and drive in a well fitted key.

(41) A. D. writes: I wish to know how I can prepare pulp for casting papier mache heads, similar to masks or false faces, in a plaster cast; or would it be better to make the cast out of some other composition. A. Paper is pulped in a mortar (or pulping engine) and mixed with ordinary glue size thinned somewhat with hot water. Remove the pulp and let it partially drain upon a linen covered frame. Put a quantity of this into the mould under strong pressure, and let it remain until it becomes hard enough to handle. A counter mould is used in casting such thin sheets. Plaster moulds are too fragile. Casts in type metal or fusible metal are much better. See SUPPLEMENT, No. 17.

(42) J. W. asks (1) if there is any cloth or knit work that will conduct electricity. A. Cotton and linen are conductors of static electricity. Cloth having filaments of metal will conduct dynamic electricity. 2. Is there any cloth that will not conduct it, the cloth or goods being dry? A. Silk is a non-conductor of electricity, but of course a static discharge would pass through a silk fabric. 3. Give some simple method of telling whether a battery gives a current of electricity or not. A. Touch the ends of the wires to the tongue when they are connected with the battery, and then do the same thing when they are detached from the battery. If you discover no difference the current must be very feeble or absent altogether.

(43) S. B. D. asks: 1. How can I regain the silver from an emulsion as described under the head of "Emulsion for Amateurs," in SCIENTIFIC AMERICAN SUPPLEMENT, No. 226? A. Mix with about three times its weight of warm water, slightly acidified with hydrochloric acid, and let it stand. Collect the chloride of silver upon a filter, wash it with warm water, and mix it with a few fragments of clean zinc and enough dilute sulphuric acid to cover it. When the chloride is reduced pour off the acid liquid, pick out what remains of the zinc, wash the spongy metal with hot water, and dry it. It may be obtained in the form of a button, if desired, by mixing it with a little borax and heating the mixture strongly in a small black lead crucible. 2. How can I make the iron develop for the same? A. Protosulphate of iron, 2 drachms; dissolve in 8 oz. water and add 2 drs. glacial acetic acid and 2 drs. alcohol. 3. How is albumen paper made? A. Albumen can be obtained from any dealer in photographic goods. It is ordinarily prepared by beating up egg albumen to a froth with a little floured salt (about 15 grs. salt to each egg), and after this has stood twelve hours to subside, floating the paper upon its surface in such a manner that every part becomes uniformly coated, after which it is fastened to frames to dry in the air. 4. Can I use French gelatine? If not, where can I obtain Nelson's? A. Yes. See our advertising columns and Hints to Correspondents. 5. I am making an induction coil of the following dimensions: Core 3 inches long by ½ inch diameter of No. 18 annealed iron wire; primary, two layers of No. 18 copper cotton covered wire; secondary, 14 layers of No. 36 silk covered copper wire, with a condenser of 300 square inch surface. What size spark can I get using two Leclanche batteries? A. You may be able to get a spark from one-eighth to three-sixteenth inch long. The coil is rather small for sparks.

NEW BOOKS AND PUBLICATIONS.

THE MAGAZINE OF ART. Cassell, Petter, Galpin & Co., 739 Broadway, New York.

The April number of this *Art Journal* is, like the previous issues, full of engravings of choice and artistic works, consisting of elaborately carved oak furniture, ancient mosaics, and other art objects of rare beauty. The most interesting of the various subjects illustrated is an engraving of the French artist, Bonnat's, famous painting of "Ribera at Rome," which was recently sold by Knoedler & Co. for about $12,000 to a gentleman in this city well known in art circles, as a collector of rare and costly pictures. This number also contains a portrait of Bonnat the artist.

SWINTON'S SUPPLEMENTARY READERS. IN SIX BOOKS. I. EASY STEPS FOR LITTLE FEET; II. GOLDEN BOOK OF CHOICE READING; III. BOOK OF TALES; IV READINGS IN NATURE'S BOOK; V. SEVEN AMERICAN CLASSICS; VI. SEVEN BRITISH CLASSICS. Edited by William Swinton and George R. Cathcart. New York and Chicago: Ivison, Blakeman, Taylor & Co.

These readers are intended to supplement any series of school readers, the volumes falling in severity of requirement between the several numbers of the more technical and formal school books in use. In this way they offer half a dozen oases in the ordinary desert of elementary instruction in reading, and are open only to the possible objection that children may not take kindly to the less charming books of the regular series after enjoying these. Certainly in beauty of mechanical make up and illustration, as well as in the excellence and appropriateness of the selections for reading, they far surpass anything in the line of school readers that have come to our table.

THE MICROSCOPE.

Charles H. Stowell, M.D., and Louisa Reed Stowell, M.S., both of them writers and observers of distinguished ability, have commenced the publication, at Ann Arbor, Mich., of a new bi-monthly magazine, entitled "The Microscope and its Relations to Medicine and Pharmacy." It is a handsome periodical, and cheap enough in price, namely, one dollar a year. We welcome this new work. The first number is highly creditable to the editors.

THE DIET CURE. By T. L. Nichols, M.D. New York: M. L. Holbrook & Co.

An essay on the relations of food and drink to health and disease. The author believes that men eat and drink too much, both in quantity and variety, and that the average death rate is double what it would be were temperance and intelligence more the rule in eating and drinking. He also has a vast assortment of notions and crotchets about food and drink which are much less worthy of general acceptance. The professional dietarian is too prone to set up his individual likes and dislikes as rules for all men, overlooking the obvious fact that, injurious as indiscriminate and excessive eating and drinking may be, the extreme of water drinking vegetarian dietetics is quite as bad; if anything the latter is less conducive to, or at any rate less associated with, forceful and enjoyable living than the former. The men and women who determine and control the world's affairs, who are strongest in thought and deed, are not generally or exclusively fed upon brown bread and roots.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

April 5, 1881,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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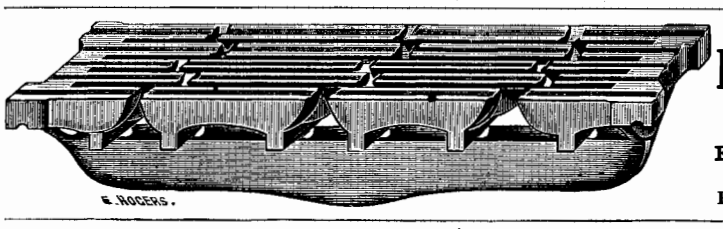

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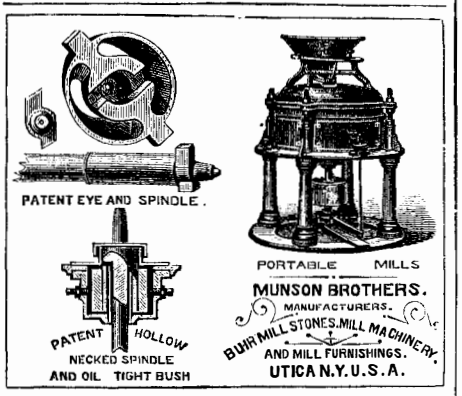
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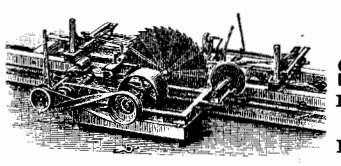

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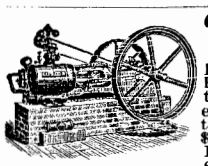

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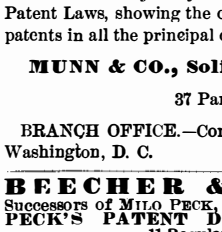

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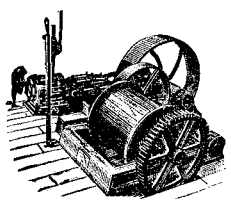

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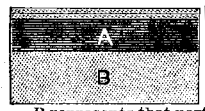

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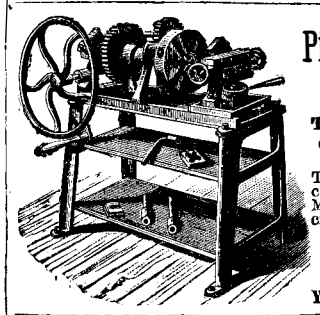

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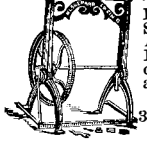

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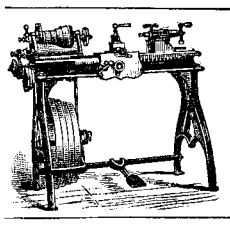

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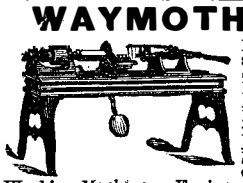

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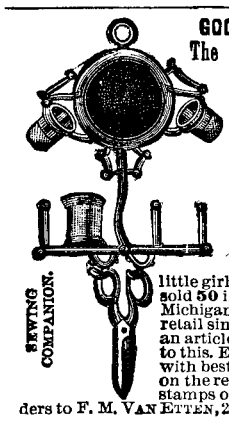

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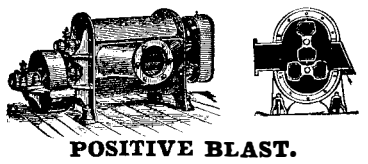

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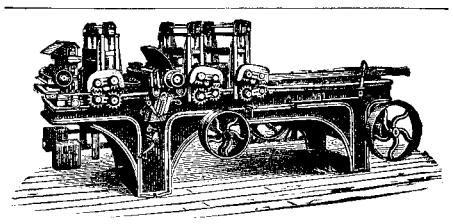

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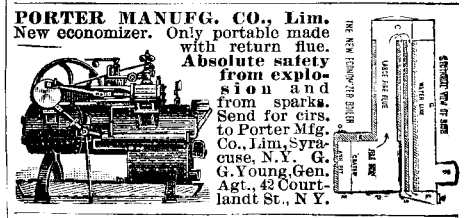

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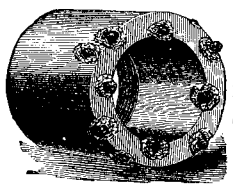
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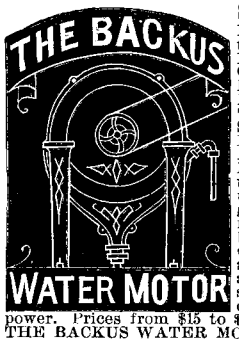

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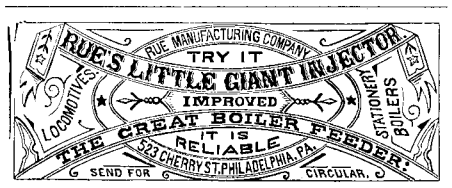

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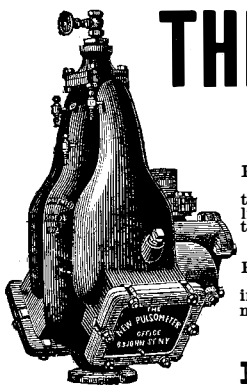
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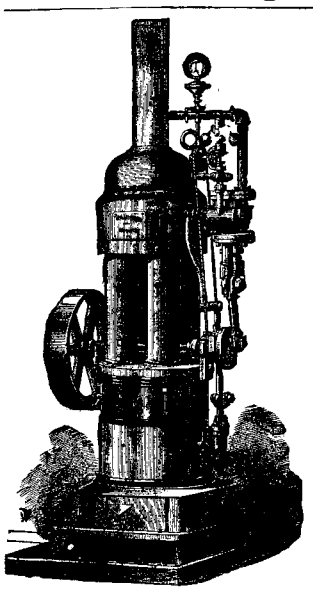
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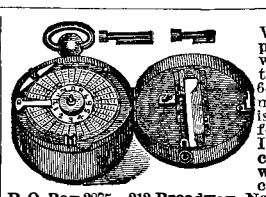
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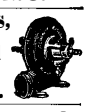

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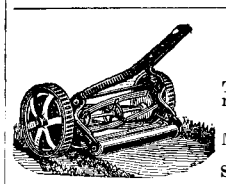
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